NATIONAL PETROLEUM NEWS

January 5, 1944

TECHNOLOGY DEPT.

Keep *this* torch burning, too

★ It may never win a place in the history books as a secret weapon. But, today, the flame-spitting acetylene torch is as much a fighting tool as a tank rumbling toward Rome or a bomber over Berlin.

More and more throughout the industrial world, its white hot blast is cutting up obsolete metal equipment, tearing down unused steel structures, starting scrap on its way to the furnaces. And this fiery flame must continue to burn. Every fighting man must have 4,900 pounds of steel to back him up. *Half of this must come from scrap metal.*

What are we in the petroleum industry doing? Idle and outmoded stills have been razed. Hundreds of miles of unreclaimable pipe have been contributed. Thousands of obsolete pumps, compressors and tanks have been turned in to swell the flow of scrap for war.

Enough? No. Until every occupied country is freed from Nazi domination, until the flag of Nippon no longer flies over Bataan and Wake—there is need for more scrap.

So, keep this torch burning. It is *one* good way to make certain that *another* torch will burn forever around the world.

One of a series of advertisements sponsored by equipment manufacturers and oil companies as a contribution to the national war effort

R. v.36 Ja-Mr 1944

SERVING FAITHFULLY

IN EVERY CLIME AND CLIMATE

Wherever you may go today, either in the service or out, you are likely to find a Tokheim pump quietly performing the work assigned to it. For in hundreds of camps and military centers throughout the world, as in towns and villages from Alaska to Arabia, Tokheim pumps are serving their masters faithfully. The conditions of service matter little. For these pumps have always been built to operate with unvarying efficiency in scorching heat or sub-zero cold, and the strenuous demands of global war have only accented this well-known Tokheim characteristic.

When you need new pumps, see your Tokheim representative, or write the factory. These famous pumps may still be purchased under government regulations.

TOKHEIM OIL TANK AND PUMP CO.
DESIGNERS AND BUILDERS OF SUPERIOR EQUIPMENT
FORT WAYNE FOR 43 YEARS INDIANA

QUALITY TOKHEIM
THE 4-SEASON PUMP

ARMY E NAVY
KEEP ON BUYING WAR BONDS

A big tanker like this can carry about 6,300,000 gallons of aviation gasoline. That gallonage of automobile gasoline would be enough normally to supply all the motorists in a city the size of St. Louis for three weeks. And this is but one ship out of the vast fleet now supplying United Nations' fighting forces.

6,300,000 Gallons of Air Raid

... on its way to Berlin

▶ It's easy to see why there's less gasoline in the U.S.A. for civilians.

Also why there's less Ethyl fluid available for your gasoline.

For every gallon of fighting grade aviation gasoline contains a generous portion of Ethyl antiknock fluid. Today, not only is more Ethyl fluid needed for more aviation fuel, but more of it is going into each gallon.

What happens after the war—when most of this high octane gasoline can stay home? You'll have gasoline for *your* automobiles, trucks, buses and farm tractors of higher quality than ever before. And when engines are designed to take full advantage of high-octane fuels, you'll get more work, more power, more economy out of every gallon.

In this post-war development, through its laboratories in Detroit and San Bernardino, the Ethyl Corporation is prepared to play a special part. Though we are not directly engaged in the manufacture of fuels, engines or engine parts, we belong to both the oil and automotive industries. Thus we will be able to cooperate with both groups; to help them unite their individual efforts toward the ultimate peacetime goal of making future transportation better and cheaper.

* * *

ETHYL CORPORATION

Manufacturer of Ethyl fluid, used by oil companies to improve the antiknock quality of aviation and motor gasoline

CHRYSLER BUILDING, NEW YORK CITY

ETHYL BRAND OF ANTIKNOCK COMPOUND — ETHYL CORPORATION — TRADE MARK REG. U.S. PAT. OFF.

Sam Wilkes . . .

Takes Key PAW Post in Dist. 1

ANOTHER INDEPENDENT OIL MAN becomes a key figure in PAW with the appointment of Sam Wilkes of Springfield, Mass., as assistant to the director-in-charge of PAW District 1. Mr. Wilkes, 39, is the president and treasurer of the Crown Petroleum Corp. of Springfield. Throughout New England he is known as a battler for the independent cause.

His father, Nathan Wilkes, was one of the first independent oil men in Connecticut, and Mr. Wilkes admits "The experience and training I acquired around his business during my school years shaped my attitude and thinking on problems of the independent."

Mr. Wilkes was born on Oct. 23, 1904, in Hartford, Conn., received his grade school and high school education there, and then attended Connecticut University at Storrs, Conn. After college he became a salesman for Gulf Oil Corp. in the Greenfield, Mass., plant. After a short service with Gulf, he joined the Sinclair Refining Co. In 1934 Mr. Wilkes ventured out on his own. He started a small fuel oil business in Springfield, Mass., saw it grow quickly, and in 1936 he formed his present Crown Petroleum Corp. of which he is the sole owner.

"In my new job I hope that the influence of independent thinking will result in some slightly better decisions for some independents who are not able to express themselves", he says. "I am taking the PAW job at great personal sacrifice because I believe there is a chance to do some good. One thing is sure: the new post won't be an empty job while I have it."

NEW WARTIME EDITION

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Don't Miss These In This Issue

U. S.-Gulf Oil Corp. tie-up seen in development program for Kuwait. Gulf President Drake and Petroleum Reserves Corp. President Ickes visit Roosevelt. P. 3.

* * *

Two vacation states, Florida and California, suffer gasoline drouth. NPN writer, on the spot in St. Petersburg, gives first-hand account. P. 4 & 5.

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Attorneys charge entrapment by OPA in appealing suspension order issued for acceptance of "R" coupon for highway use. P. 6.

* * *

Ex-oil man Ed Moore withdraws from Senate group counted upon to support legislation to raise crude oil price ceilings as Congress prepares to return Jan. 10 to agenda listing many oil items. P. 8.

* * *

ODT reports on survey showing essentiality of tank trucks in war effort. P. 19.

* * *

Refiners seek to break legal dikes holding Texas crude from District 2 and keeping 200,000 b/d of capacity idle. P. 24.

* * *

New Jersey Standard reviews Canol project, gives terms of contract. P. 30.

* * *

Socony-Vacuum research chief visions future of transportation in America, forecasting a 1953 car that uses only half as much gasoline per mile as 1942 models. P. 41.

Change the Name!

Marketing or Distribution? On Page 15 you'll find an editorial in which Editor Platt suggests that PAW, now reorganizing its divisions and changing the names of some, lead the way and start designating this all-important function of the industry as "Distributing" instead of the misnomer, "Marketing", that has been used erroneously over the years.

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NATIONAL PETROLEUM NEWS

January 5, 1944
Volume 36, Number 1

PRC Shops for Gulf's Near East Oil

Dicker Over Holdings at Kuwait, Arabia, Disclosed When Ickes Pays Call at White House with Company's President in Tow

NPN Staff Special

WASHINGTON — Following failure to make a deal with California Arabian Standard Oil Co. in Saudi Arabia, Petroleum Reserves Corp. now is negotiating with Gulf Oil Corp. looking to a possible joint government-industry development program in Kuwait, at the head of the Persian Gulf.

Tip-off that a deal with Gulf is in the wind came when PRC President Ickes, with Gulf President J. F. Drake in tow, dropped in at the White House last week for an hour-long talk with President Roosevelt. Both were mum as to what transpired.

The possibility that PRC may continue to function after the war was seen in another comment by Mr. Ickes. He had just finished telling his press conference that PAW would be disbanded after the war when a reporter popped up with the question: "What about PRC?"

It's 'All Inchoate'

"PRC has nothing to do with the domestic situation," Mr. Ickes replied. "We don't know yet what will happen to PRC—that's all inchoate."

As to whether PRC actually has nothing to do with the domestic situation, forthright Sen. Ed. Moore of Oklahoma let it be known that he has doubts as to that. Speaking out at Ft. Worth, Tex., on Dec. 23, the Oklahoma solon visualized the formation of PRC as "the initial step in the New Deal's plan to take over the oil business," and added:

"The powers of this corporation, although confined to exploration and refining in foreign fields, leave the corporation wholly free, however, to market petroleum and petroleum products anywhere within the continental United States. The charter, by its own terms, may be amended from time to time, and undoubtedly, men with ambitions, such as Mr. Ickes, will lose no time in attempting to take over the development and operation of our petroleum interest in the public lands and naval reserves . . .

"There is no place in our government for PRC. In my opinion, it should be dissolved and liquidated at the earliest possible moment, and those inexperienced and ignorant but ambitious people who would destroy our form of government should, by law, be prohibited from engaging this government in private business."

PRC is known, however, to have long been casting interested glances in the direction of Kuwait among other places in the Persian Gulf area.

Gulf and Anglo-Iranian Oil Co. hold the entire oil concession on a 50-50 basis under a grant from the sheik of Kuwait. Gulf's arrangement with Anglo-Iranian is understood to provide that the American company may not market products in any area in which the British already are marketing, except with that company's special consent.

Although only 9 wells have been drilled so far, on a pattern of about one to every five square miles, proven reserves are reported to total between 8 and 10,000,000,000 barrels, making this one of the richest concessions in the Near and Middle East. Inasmuch as Kuwait was one of the way-points scheduled to be visited by the DeGolyer mission during its current look-see at that area for PRC, actual completion of PRC's negotiations with Gulf probably will await the expected early return of the DeGolyer group to this country.

While he was silent on the subject of Kuwait, PRC Chief Ickes was not so reticent on the recent report of PAW'S Foreign Operations Committee outlining a suggested foreign oil policy founded on the principles of private enterprise.

In the following words he virtually disowned the report, leaving newsmen with the distinct impression that he didn't believe in it and wanted none of it. "I have no opinion on that," said Mr. Ickes, tersely, adding: "By the way, that was a volunteered report. I didn't ask for it. I didn't know they were working on it. They just came in and handed it to me."

PAW Eases PAO 11 Materials Restrictions

NPN News Bureau

WASHINGTON—To step up production further, PAW this week relaxed the restrictions of PAO 11 as far as the present situation will permit on use of critical materials in crude production and natural gas and natural gasoline operations. The action was taken in amendment to PAO 11, effective Jan. 1.

PAW Ickes said the relaxation would permit oil operators to use critical items on a slightly larger scale than had been possible up to now. Present conditions, he said, warrant the use of these materials, particularly in view of the pressing need for the utilization of every facility that may encourage efforts to increase crude production.

In effect, Mr. Ickes said, relaxation of use restrictions will enable operators to work over their producing wells and to further develop known reserves within presently producing fields. He emphasized, however, that any increased production that may be obtained will not necessarily increase the net productive

(*Continued on p.* 11)

Boyd Outlines 1944's Prospects for Oil

NPN News Bureau

NEW YORK—A U. S. army of 5,000,000 overseas by the middle of 1944, trebling the nation's requirements for fighting oils. The military machine must not slow down, so the civilian must.

Centering his argument on this hard alternative, W. R. Boyd, Jr., President of the American Petroleum Institute and chairman of PIWC, issued his year-end statement to the industry as last week ended. He forecast that coming months would be hard ones for the petroleum industry and civilians dependent on it but was confident on the main proposition of his discourse: "Where Eisenhower Will Get His Oil."

Petroleum will do its part and meet all demands, was the conclusion of his statement, which follows:

"The awful drama of war in which the American fighting man is now playing a leading part, with petroleum in the principal supporting role, now comes into the third-act climax for which the whole world is waiting. I say the whole world because I feel certain that our enemies are now as certain of defeat as we, of the United Nations, are confident of the victory which Gen. Eisenhower has promised us in 1944 if we all do our part.

"The world knows that, given the continued opportunity, the American petroleum industry will find the ways and means of keeping the people of the U. S. adequately supplied with the petroleum products that are no less essential in peace than they are vital in war.

"The year 1943 witnessed the virtual completion of the mobilization of the petroleum industry for war. Just as 1942 was a year of adjustment to the impact of war so 1943 was the year in which most plans materialized and preparations became actions. The closing months of 1943 clearly witnessed the 'end of the beginning' and just as surely marked the 'beginning of the end' for the Axis. The all-out effort of the petroleum industry to keep our fighting forces supplied with all the oil needed not only hastened, but actually made possible the tipping of the scales of war against the enemy.

"The coming months will be hard ones for the petroleum industry and for the civilians of this country who must get along on the oil which remains after supplying military needs. The production of crude oil has not received the same encouragement or incentive to expand as has the production of other vital commodities such as aluminum, mag-

(*Continued on p.* 40)

Directive 59, Political Shenanigans, or What?
Ask Irate Floridians Battling 'Gas' Drought

By Herb Taylor
NPN Staff Writer

ST. PETERSBURG, Fla.—It may be directive 59, or maybe sinister politics, but in this winter resort city of over 100,000 there is a gasoline shortage so acute that last year's shortage on the East coast was a mere nothing in comparison. A coupon is a hunting license. If you have the time and the right connections you may be able to trade your "A" coupon for a gal. of gas if you can find the gas. Otherwise you are just out of luck, as has been true of hundreds of motorists in the past two weeks.

These motorists, many of them war workers in nearby Tampa's shipbuilding yards, about two weeks ago suddenly found themselves confronted with "no gas" signs at their favorite stations. They found the condition true at other outlets. Cars were stranded on highways, on the Tampa-St. Petersburg Gandy bridge and on the streets.

The arrival of a tanker at the Port of Tampa containing a mere 3,000,000 gal., prevented a complete freeze of all local transportation. This shipment which arrived at the Sinclair terminal, was allocated to this area, in accordance with the provisions of Directive 59, which was a mere drop in the bucket for the St. Petersburg area, which increases about 40,000 in winter over the summer population. Much of this increase is composed of northern invalids, sent South on their doctor's orders. Some shipped their cars, others drove with proper OPA permits. But the fact remains that those who are here are using no more gasoline than they would in the critical and northern areas.

Many Reasons Are Given

There are many reasons given for the gasoline shortage, depending on who you are talking to. The average man on the street has been sold on the idea that a 3,000,000 gal. tanker arriving late caused the trouble. As a matter of fact, one storage plant in St. Petersburg alone —and practically all companies are represented—has a storage capacity of 800,000 gal., and the Standard plant in Tampa has 40,000,000 gal. storage. A shipment like that would compare with a bottle of pop at a picnic. Others think that tankers are being sunk by the enemy, which is improbable as they are not that kind of tankers and only come across the gulf from Texas and Louisiana. The Chamber of Commerce intimates that it is a California publicity stunt to divert attention from the West Coast's own shortage.

But the whole answer according to well informed oil men is the failure of Directive 59 to work in this area. These oil men enthusiastically subscribe to an editorial in the *Tampa Daily Times*, which was reprinted on the front page of the *St. Petersburg Independent* on Dec. 22. This editorial, consisting of liberal quotations from the NATIONAL PETROLEUM NEWS of July 7 and 14, reads in part as follows:

"The truth about the Tampa area's gasoline shortage, apparently unrevealed by the Petroleum Administrator for War, Harold L. Ickes, the self-styled old curmudgeon of the New Deal administration, may be found by putting together reports in the July 7 and July 14 issues of NATIONAL PETROLEUM NEWS magazine with present conditions.

NPN Article Quoted

"In the July 7 issue, a special story written by a Washington correspondent of the magazine was captioned, 'Governor Holland claims tax figures show gasoline is backing up in his state and ration should be hiked; capital PAW finds letter hard to answer.'

"Mr. Ickes has had Governor Holland's letter since June" said the story. "His staff is having difficulty agreeing on an answer because the governor has raised some embarrassing questions on PAW figures on Florida's gasoline's stocks. Florida's inspection tax law, with refunds for exports from the state, provides detailed data on inventories. These show steadily increasing stocks for some months while PAW had contended stocks were declining.

"PAW has done its best to siphon off surplus stocks from Florida and Georgia for movement north, but inventories continue to climb. So why not allow Florida and Georgia A card holders a four-gal. gasoline ration instead of 1 and 5-10th gallons is the question asked. . . .

"In its July 14 issue, A. M. Petty, news editor of the magazine wrote as follows under the caption: PAW's Face Is Red Over Southeast Situation:

" 'The southeastern gasoline situation is going to embarrass PAW even more before it's finally settled . . . during the interim, PAW will have to take Florida and Georgia out of the East coast shortage area or else try to dry up complaints from that area by diverting their transportation facilities elsewhere.

" 'Only place to dump the Florida-Georgia surplus would be into the Carolinas. That would increase supplies there. Carolinians would ask: Why wasn't this done long ago? . . .

" 'Florida wouldn't take this lying down. Only a few weeks ago Governor Holland asked authority to seize and operate oil transportation facilities in the state. A bill for this failed by several votes, defeated only after frantic pleas from Washington.

" 'What wouldn't the Florida legislators do, if PAW asked to take away their barges and tankers?

" 'But that's just what PAW may be fixing to do. It plans to dry up Tampa as a supply terminal. shifting operations to Jacksonville. Savannah's supply terminal will be reopened with those at Charleston, S. C., and Wilmington, N. C., will be enlarged. . . .

" 'There is a dark hint in PAW Ickes' letter to OPA Chief Brown that Florida and Georgia may lose some of their barges, tankers, and other facilities. It may become necessary, writes Mr. Ickes, to divert some transportation facilities to take care of military emergencies.

" 'When and if PAW diverts from Florida and Georgia transportation facilities, some senator or congressman may be smart enough to telephone the Army and Navy to see if there have been any military emergencies lately in the Southeast.' "

"When the Times asked PAW in Washington Monday to give the reason for Tampa's gasoline drought, a spokesman said the Tampa shortage was due to the fact that tankers had not been coming into the port on schedule.

"From a great surplus in June and July to a critical shortage in December, is the gasoline record for the Tampa area," said the Times.

"Distributors here have said quotas were cut by PAW.

"Some emergency supplies came in from Jacksonville which might give emphasis that Jacksonville is increased as a terminal and Tampa decreased:

"So the fact that Governor Holland

Typical line-up at a St. Petersburg station as "gas famine" hits Florida, as intimated last July in NPN

told the truth which embarrassed PAW may be the reason that Tampans have been made to feel the shortage," the editorial continued.

"Bungling bureaucrats never like to be caught with their faces red.

"And if petroleum bureaucrats headed by Ickes, the curmudgeon, and Deputy Davies, deliberately have created a shortage here just to show at least a part of Florida that it can be done, then it is time for the Florida delegation in Congress to see that there is an immediate end to the discrimination.

"No official hint has come that military security has anything to do with the shortage. Is retaliation the motive?"

Operators Do Best They Can

Service station operators appear to be doing the best they can to portion out their meager supplies equitably, but they find it hard to do. Persons using their cars for pleasure only, are driving from station to station as fast as gasoline arrives, and are getting the lions' share.

Tampa sources have brought the present gasoline shortage to the attention of Senator Andrews, and he in turn is preparing to ask Mr. Ickes for an explanation, local sources say.

New Year's eve found gasoline in St. Petersburg just as scarce as it was before Christmas. Many stations were closed on account of lack of motor fuel. Some companies, with a small storage on hand, closed their December books early and started on the January allotment. They did this with their fingers crossed and with a hope and a prayer that before the end of January Directive 59, which they blame for the shortage, will be moderated.

Stations that were selling gasoline had cars lined up for two blocks waiting to get to the pumps. Each car would move up one car length and then stop and wait until the first car in line got "gas" and moved away. It was figured that each car except those that got there first, used a gal. of gas while in line and battery on each car suffered.

Buses and garbage trucks will continue to operate because a reserve supply of gasoline was held for the city.

J. E. Hough, local manager for Standard Oil Co. (Ky.) designated one of the local company stations for holders of "C" ration books only. The local rationing board reported Mr. Hough's arrangement, adding "This service is primarily to see that war workers and physicians who have C books and whose driving is essential, will be able to get gasoline".

Co-Ops Buy 5 Refineries In '43

NPN News Bureau

NEW YORK—The last regular bulletin issued by Cooperative League of U. S. A. points that American Consumer Cooperative purchased 5 oil refineries, more than 1000 miles of pipeline and 264 oil wells during 1943. The Bulletin states that they also built one oil compounding plant and drilled half a dozen of their own oil wells in addition to those purchased.

'Gas' Famine Settling Down on Pacific Coast; PAW Talks Special War Workers' Ration

NPN News Bureau

LOS ANGELES—The long predicted gasoline shortage has descended upon the Pacific Coast. Thousands of service stations are reported closed for lack of gasoline and PAW is working out an emergency plan whereby war workers can obtain gasoline to get them to their plants.

Deputy PAW Davies, who is in Los Angeles to work out details of the emergency ration, has announced that unless the shortage clears up within the next week or two his agency will act.

This would be in the form of a directive designating certain gasoline stations to serve war workers only. PAW will see that these stations are supplied, and war workers will be provided with special identity cards through co-operation of war plants and the army.

Mr. Davies made it plain, however, that this was considered only as a last-ditch measure.

"Mr. Bowles of the OPA has been informed of the unpleasant facts, and he is as worried as we are," Mr Davies said. "I am hopeful his interest will be productive."

18,000 Per Day Short

"Unpleasant facts" of the Pacific Coast situation were given as these. There are just 135,000 barrels per day of gasoline in District 5 for civilian use. Present consumption is at the rate of 155,000 barrels daily, or 18,000 in excess of supply. This difference, for several months, has been made up by taking gasoline out of storage. However, it has got to the place now where storage can no longer be reduced, and the Pacific Coast must drive within its gasoline allocation.

Speaking of Dist. 5, Mr. Davies said: "There are more coupons afloat than there is gasoline to redeem them. Therefore, we have rationing by stock exhaustion. There is no equity in this sort of rationing."

Asked about the possibility of imports from Texas and the Gulf Coast, Mr. Davies said the outlook was not good.

He pointed out that imports into California at present were running between 30,000 and 40,000 b/d, coming from the Gulf Coast by tank car. However, ODT has informed PAW that any increase in the present import rate can be attained only at the expense of other critical materials. Tanker shipments are also out for the time being, Mr. Davies said, for these ships are needed elsewhere.

To the direct question, "What are the chances of a Texas-to-California pipeline?" Mr. Davies answered that they were definitely "not good." He then explained that while at the present time there is an excess productive capacity in Texas and New Mexico of about 200,000 b/d, this condition would not exist by next spring. New transportation facilities will be in operation by spring, Mr. Davies said, that will take this excess productive capacity to the middle western area so there will not be any crude left for the proposed Texas-to-California pipeline.

A little humor was injected into the Davies press conference here when one reporter asked: "Do you think the Fulton Lewis, Jr. plan would help the situation in California?"

"Which plan is that?" asked Davies.

"For a 35c increase in crude oil prices," answered the reporter.

"Oh, that," said Davies, "Yes, I think it would help, but we at PAW like to think we had something to do with the idea, although we appreciate Mr. Lewis' help."

In course of questioning, Mr. Davies was asked if it were not true that in the Elk Hills Naval Reserve there were thousands of acres of potential and proved oil land that might be drilled.

"I believe that is correct," he said. "However, drilling Elk Hills is a navy matter and PAW has no control over what the navy does with this reserve."

Reese Taylor, president of Union Oil Co. of California, lashed out against the OPA and Mr. Davies' plan for war worker stations.

"OPA has done everything from the outset to hinder the oil industry, both in rationing and prices," he asserted. "It it utterly ridiculous to have been writing out coupons without considering the available gasoline supply for civilians. They don't know how many coupons are out nor how fast they are used. They have almost no control over the rate of use—all in a day or all in two or three months."

He doubted if the PAW plan for special stations for war workers would work unless the army surrendered some of its own gasoline, adding that he didn't think the army "will monkey with control of civilian supplies."

"Coupon Cuts?" "Maybe"

With everybody else issuing statements, OPA also got on the bandwagon.

Frank S. Balthis Jr., district director, said: "We don't know whether there will be further cuts in coupon value or not. Or whether any effort will be made to install a system of rationing gasoline according to district and board quotas. But in an exact ratio of greater withdrawals of gasoline from this area by the army and navy, civilian supplies will diminish."

Summing up, everybody seemed to agree with Mr. Davies when he said that the present 135,000 b/d of gasoline is the "absolute maximum in the West for the duration and there is considerable likelihood of less."

The difficulty, of course, with the California situation is an actual shortage of crude oil. Transportation, which was the underlying cause of the Eastern Seaboard shortage has nothing to do with the Pacific Coast troubles.

Attorneys Charge Entrapment by OPA in Appeal Of Suspension for Accepting 'R' Coupon

NPN News Bureau

CHICAGO—Attorneys for the Central West Oil Co., of Kankakee, Ill. have filed an appeal with OPA at Washington against the rulings of a hearing commissioner at Indianapolis last month.

The company's attorneys protest that the company, itself was not guilty of any crime even if the service station attendant was, and that the suspension from business for 30 days should not be levied on the company.

The attorneys also declare that the OPA investigator had entrapped the station attendant, contrary to law.

If OPA at Washington does not sustain the company's contentions the attorneys say they will appeal to the Federal courts. The attorneys are John W. Dorgan of Chicago and Paul R. Summers of Indianapolis.

The story of this case, as unfolded in the transcript of the testimony, seems to start with a former temporary employe at one of the company's stations at Muncie, Ind. This man some time after he left the company's employ, was ordered off the premises by the station supervisor after holding the station telephone for 40 minutes, and this was his second offense in that regard. This man threatened to "get" the company and the supervisor. He complained to the police and then to the OPA rationing board telling a story of how he and others at the station had accepted illegal ration coupons.

Seeks Out Ex-Employe

An OPA investigator was given the complaint. After several attempts the investigator located the ex-employe, then prevailed on the ration board to loan him an "R" coupon and then got another investigator to present the coupon while the first investigator and the ex-employe trailed behind and acted as witnesses.

The attendant who took the "R" coupon testified that the OPA man in proffering the coupon said he had to drive to a nearby town but the investigator says he only handed the coupon over and asked for "gas." The commissioner overruled the request of the respondent's attorneys that this was entrapment. The commissioner also refused to rule on whether the OPA investigator and the rationing board had violated the law in his getting the "R" coupon and in offering it for gasoline knowing that it was illegal.

(The OPA chief hearing administrator at Chicago has since roundly condemned a magazine writer for thus proving that OPA rules are being violated, holding that even if the writer was after evidence of crime, it was illegal for him to get it, and that that made the writer guilty. He was suspended for 1 year).

The transcript of the Indianapolis hearing shows that the station attendant who took the "R" coupon testified that he was "manager" of the station which the hearing commissioner, Dennis F. Dunlavey of Region 3 headquarters at Cleveland, said made the company liable for the "crime." The transcript also shows that the auditor of the business, M. J. Flanagan, testified as to the decline in gallonage at the station when rationing went into effect, and how the gallonage continued to drop, this to refute the statement of the investigator that the station was doing a big business because of allegedly taking illegal coupons. The station balanced over the year to within seven gallons.

Kenneth Parker, supervisor for the company, testified to the rules of OPA being sent to the stations and called to their managers' attention.

Seeks to Improve Relations Between OPA and Jobbers

NPN News Bureau

CHICAGO—In an open letter to Independent Oil Jobber associations and motor fuel tax departments in the Middle West, W. H. Barber Co. of Chicago asks cooperation in developing a better relations between OPA and independent jobbers.

"Certain things which have been happening recently cause us to wonder if the enforcement division (OPA) may not be following up leads (in all sincerity as far as they are concerned) to which they have been directed by someone who has an axe to grind," the letter said.

Sent out over the signature of James R. Taylor, company vice president, the letter then cited a hearing in Indianapolis wherein a jobber was given a 30-day suspension because an employe accepted an "R" coupon for gasoline placed in the automobile of an OPA investigator.

The letter continues, in part:

" . . . The sales at the station in question showed a decline of 50 to 75% from a year ago. Any of you know that if this station were wilfully participating in black market activities there would be no such decline in gallonage. While the particular violation no doubt was proved to the satisfaction of the hearing commissioner, we do not feel that this particular type enforcement is beneficial either to the Office of Price Administration or the oil industry, for the reason that, (and I am sure that you will all agree with me in this), the procedure used in the first place does not meet with favor, while in the second place, it puts the employer entirely at the mercy of his employe. There is no question in our minds that most any employe at a service station has some friend whom he would endeavor to take care of in some such manner by accepting "R" coupons, T coupons or others, so long as he could in some manner obtain the coupons to turn in to his employer, knowing in advance that he personally is not in jeopardy as far as OPA regulations are concerned.

"I had occasion to attend a hearing in Chicago on Dec. 20, at which one of the largest oil jobbers in the State of Illinois appeared before the hearing commissioner. The Office of Price Administration apparently has used about six investigators over a period of weeks in building up a case against this jobber, and the case blankets his entire operations including 13 company owned and operated service stations and four company owned and operated bulk plants.

"So far as I can determine from my short attendance at the hearing, this company's coupon account is in balance, but it looks as though the Office of Price Administration are setting out to prove that this company has deposited coupons on which license numbers do not appear; from all stations. It further looks as though they intend to prove that some license numbers have been placed on coupons by the station attendants, or others, when the customer made a purchase without writing in the license number himself; and that the license number finally written in does not always correspond with the license of the car which actually made the purchase. . . . I have talked to scores of jobbers and without exception, they all tell me that in all probability their own employes are doing the same sort of thing when they get pressure from the home office not to take coupons without license numbers. While something else may be brought out before the case closes, at the moment it looks as though this jobber may be convicted of a practice which we suspect would close every retail outlet in the Middle West. If that is so, it further seems to us that the time and money spent by OPA in so thoroughly blanketing this one jobber's activities is not in keeping with the apparent seriousness of the crime. . . .

"Again I say that the field force of the Office of Price Administration could unwittingly become a victim of an exceedingly vicious practice. Unless we cooperate with the Office of Price Administration to prevent that, in our opinion, we will soon reach the point where jobbers will be pointing their finger at the major company lessee and the major company lessee will be pointing their finger at the jobber and each running to the investigators of the Office of Price Administration trying to get the other fellow put out of business. We think it exceedingly bad for public morale and exceedingly bad for the oil industry to permit such a happening to take place. . . .

"We think it is unfortunate that the

OPA Asks Court Enforce Order On Endorsing "Gas" Coupons

Special to NPN

DALLAS—Injunction suit to enforce regulation that dealers must not accept coupons unless motorist has written license number and state thereon has been filed in Federal Court here by OPA against Foy O. and Amos E. Wilemon, operators of Good Luck Oil Co.

OPA said this was the first such suit in the nation. It asks that the Wilemons be permanently enjoined from accepting unendorsed coupons. Judge William H. Atwell set preliminary hearing for Jan. 8.

The Wilemons were the center of a recent court case in which Judge Atwell set aside an OPA closing order against their stations.

Overruled by OPA, Local Board May Resign

ALEXANDRIA, Va.—Threatened resignation en masse of the Alexandria, Va., local ration board, when its action in revoking fuel oil rations of an Alexandria citizen was overruled by the national OPA, drew wide-spread attention this week to an issue of local board authority.

Virginia's Governor Colgate Darden involved himself in the controversy with a statement at Richmond that he would back up the Alexandria board members, "who are volunteers appointed by me," and that he would confer with his attorney general to see what authority, if any, he has to intercede in the dispute.

The row started when the Alexandria board called consumer Richard Aubrey before it to explain a discrepancy in figures on floor area of his home, as stated in his application for fuel oil allotment. After one appearance before the board, when he was kept waiting two hours and, according to the board's account, used abusive language toward the clerk for the delay, Mr. Aubrey refused to appear again in person, instead insisted that he mail the coupons and additional information required by the board or permit his wife to appear in his stead.

The Alexandria board thereupon notified his fuel oil supplier that his rations were revoked and ordered the supplier to make no further deliveries.

Mr. Aubrey appealed to national OPA in Washington stating that he was out of oil, that his pipes were in danger of freezing and that he had a 2-year-old child in the house. After several attempts to reach the local board had failed, national OPA officials notified Mr. Aubrey's supplier to resume deliveries to him.

At this, the entire Alexandria ration board submitted their resignations in a body, to be effective Jan. 10 unless the national office reverses itself by that time.

OPA's national officials, questioned by NPN, justified their intervention by the emergency nature of the situation and asserted that the local board had exceeded its authority under the fuel oil rationing regulations.

oil jobbers do not have better representation with the Office of Price Administration so that a better understanding could be reached regarding their mutual problems before they have to be thrashed out in the field.

"We hereby pledge ourselves to endeavor to bring about a better understanding between the independent oil jobber and the Office of Price Administration and we hope that your group will assist us to foster this better relationship."

Thomas A. Telfer Dies

T. A. Telfer, age 57, vice-president and general manager of the Calumet Refining Co. and a director of the Red River Refining Co., died Jan. 1 at his home in Chicago following a heart attack. A native of Sarnia, Ontario, Mr. Telfer became associated with the oil industry in 1903 when he joined the Imperial Oil Co. at Sarnia. In 1910 he joined the Fred G. Clark Co., Chicago, wholesalers of lubricating oils.

He was one of the organizers of Calumet Refining Co. in 1918 and served as the company's vice president and general manager from 1926 until his death. Mr. Telfer was a member of the lubricating committee of A.P.A., a member of that organization's 25-Year Club, a 32nd Degree Mason and a member of the Chicago Athletic Club. He is survived by his wife, Camilla W. Telfer, and two sons, Bruce, an ensign in the U.S. Navy and Leonard, a lieutenant in the U.S. Army Air Corps.

Sun Oil Chief Urges Quick Return to Competitive Basis

Special to NPN

PHILADELPHIA—Immediate return of the petroleum industry to a competitive basis was urged Dec. 31 by J. Howard Pew, Sun Oil Co. president, who in a "Year-End Statement" summarized the achievements of the industry in 1943 and set forth the prospects for the coming year. Mr. Pew's statement in full follows:

"The petroleum industry has just completed the most difficult year in its history and may well be proud of its record.

"Perhaps the most important achievement of the industry in the past year has been the completion of many aviation gasoline plants. Without the production of fuel from these plants, it would have been impossible to have put and kept in the air our huge armada of aircraft. This accomplishment without doubt substantially shortens the war and saves American lives. Sun Oil Co. has made one of the largest contributions toward advancing the program.

"Next in importance during the year, the industry has overcome the transportation problem resulting from submarine sinkings and the shifting to overseas military and naval services of the tanker fleets which normally supplied the East coast with crude oil. This was accomplished through reorganization of existing pipelines, construction of vast new pipeline facilities, building of barges for greater utilization of inland waterways and a more concentrated, efficient use of railroad tank cars. As a result, crude oil receipts on the Atlantic Coast are now at an all-time high.

Pools No Longer Needed

"During the acute period of this transportation emergency, units of the industry, acting at the request of and in cooperation with the government, pooled certain of their efforts and facilities to cope with the situation. While this may have been necessary in the war effort, it is not normally in the best interests of the industry or the public.

"Even though rapidly increasing military needs continue to restrict petroleum supplies available for civilian use, the oil industry believes that, with the solution of the transportation problem, the time has arrived when it should return to the healthy, intelligent competition that made petroleum one of the greatest industries in the world. This can be done when rationing is soundly administered. The industry, by and large, wants no relaxation of the anti-trust laws nor any immunity from either the spirit or the intent of this legislation, either now or in the postwar period.

"In order that the petroleum industry may make the great contribution to the better world of tomorrow which its technological developments promise, neither the industry nor the American people should tolerate any combination which might lead to conspiracies against the public interest.

"The competitive spirit burns brightly in the petroleum industry. The light it casts marks the way to better products at lower costs for the consuming public and more jobs at higher wages for those who comprise the industry."

California Standard Receives 1st Mexican Settlement

Special to NPN

SAN FRANCISCO—Standard Oil Co. of California Jan. 3 received a $1,913,997.59 check representing the first payment in settlement for its interest in Mexican oil properties expropriated by the Mexican government in 1938.

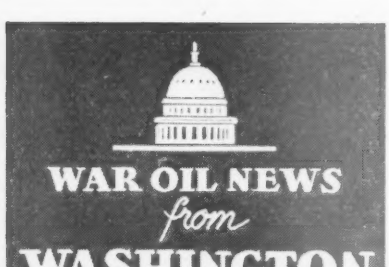
The total settlement amounts to $3,589,158 plus 3% interest from the date of expropriation. The balance is payable in four yearly installments the last of which is due in September, 1947.

The amount payable to Standard was agreed upon by the U.S. and Mexican governments last September.

Magnolia Scouting Florida Area for Oil Leases

Special to NPN

ST. PETERSBURG, Fla.—Ray F. Jarike, manager of the lease office of Magnolia Petroleum Co., at Sarasota, said a crew was to be sent there to check whether petroleum was available in this area on a production basis. The company has leased 55,000 acres in Sarasota County and is planning to increase its holdings to 100,000, Mr. Jarike said.



Odom Answers PAW In PAO 5 Battle

NPN News Bureau

WASHINGTON—The battle of words between Eastern Petroleum Importers Conference and PAW over PAO No. 5 is still going strong, with the latest blast coming from E.P.I.C. Counsel L. A. Odom.

PAW's formal answer to charges filed by E.P.I.C. with PAW Chief Counsel Marshall and Dist. 1 Director-in-Charge Dodge was contained in a letter from Mr. Marshall to Mr. Odom, filed with Sen. Aiken's farm gasoline subcommittee.

Replying to Mr. Marshall's letter, Mr. Odom says, in part:

"Your letter while a literary masterpiece of glittering generalities to my mind answers none of the questions asked in my letter, but it does raise a new issue which certainly deserves further comment.

"You refer to the cloak of self interest of my clients. Charity forbids that I should comment on that of your clients. The petroleum industry, as I see it, is a liberated, glorified, subsidized monopoly. The policies governing it have been made in large part by major oil officials, some of whom by their own admission are drawing salaries from the government and their respective companies simultaneously.

"Serving 2 masters and unselfish service do not go hand in hand. As long as this condition exists the small independent oil men such as my clients expect to hear the voice of Jacob and feel the hand of Esau when they read such orders as PAO No. 5. At least none of them fear that PAW will get the same monopoly on unselfish service they now have on the refining, transportation and marketing of petroleum.

"Wishing you and your clients a merry Christmas, I remain, very truly yours."

The next move will probably develop before Rep. Lea's Oil Investigating Committee which plans a new series of hearings starting about Jan. 20 to hear the "gripes and groans" of the independent marketers under present wartime regulations, including those of OPA and ODT as well as PAW.

Sen. Ed Moore Withdraws From Fight to Boost Crude Oil Price as Critical Session Nears

WASHINGTON—The defection of Sen. Ed. Moore of Oklahoma from the ranks of those counted on to support crude price legislation made the prospect for favorable action on the Disney and Thomas bills a bigger question than ever this week, as a Congress with many oil matters pending on its agenda prepared to resume sessions on Jan. 10.

Vigorously and forthrightly, Ex-Oilman Moore announced himself in a speech at Ft. Worth, Tex., as opposed to Congress launching itself "upon the perilous venture of fixing prices by legislation."

"There is no one more desirous of seeing the price for crude oil raised than I am," said Sen. Moore, "but in this connection I am constrained to say that we must not desert our basic principle of government by asking the Congress to legislate prices. It is no more proper for Congress to fix the price of crude oil by legislation than it is to fix the price of food, clothing, building materials and the thousands of other items we consume daily."

In language that proponents admitted would have a profound effect on other senators if repeated by him in the Senate, Sen. Moore continued that for Congress to fix crude prices would be "to establish a precedent which I do not believe the people of America and, more particularly, the members of the oil industry, want."

Might Be Reduced, Too

"It is certainly obvious," he said, "that if Congress exercises its power to effect an increase in the price of crude oil, it may at some future time exercise the same power to reduce the price of crude oil. Surely oil men will recognize that in the near future it may become politically popular to reduce the price of crude oil."

Sen. Moore said that the most effective thing Congress could do to assist the oil industry in obtaining a price raise "would be to abolish OPA and recall the authority in this regard that has been delegated to the President. If the industry were free from artificial economic restrictions, I have no doubt that the price of crude oil would seek its own level, compatible with supply and demand, and I have no fear that such true economic level would tend to or result in inflation."

NPN talked with various industry representatives in Washington and found none that did not view the Moore speech as a serious setback. At best, the Disney and Thomas bills had been in precarious position, reposing as they now are in a supposedly unfriendly committee of the Senate (Banking and Currency) and faced ultimately with a certain presidential veto in the event either should even win Congressional approval.

But though they were dismayed, proponents of the crude legislation gave no indication of giving up the fight and expressed a determination to force action by the Banking and Currency Committee. Failing in that, they will probably move to attach the legislation as a rider to some important administration measure such as that to extend the life of the Commodity Credit Corp.

While the crude price question thus is the big issue, from the oil standpoint so far as the reconvening Congress is concerned, there are other matters pending of vital interest to the industry.

Revenue Act Important

First and foremost, of course, is the new "revenue act of 1943" (H. R. 3687) which emerged from the Senate finance committee just before the recess and is scheduled for early consideration. Aside from its taxing features, the bill contains at least two sections of importance to oil.

1. A Senate committee amendment completely exempting from renegotiation all government contracts and subcontracts for all "standard commercial articles," including petroleum products, which are identical with those sold for general civilian, industrial or commercial use prior to Jan. 1, 1940. Effect of provision, if it remains in the bill—and this seems doubtful in view of administration and also senate opposition—would be to make final all present contracts or subcontracts except those on such specialty petroleum war products as 100-octane, butadiene, etc.

2. A committee-amended version of a House provision which had caused the IPAA to question the attitude the internal revenue commissioner would take with regard to charging off of intangible drilling costs in the production of crude oil, and to express "great concern" lest it lead to "a possible change in our entire depletion allowance." The House version would have empowered the commissioner to disallow deductions and credits "if they result from an acquisition of a corporation or of property, after Oct. 8, 1940, for the purpose of tax avoidance." Attention of the Senate committee was called to this provision by IPAA, which said it had no objection to legislation which, if abuses exist, would prevent corporations with large excess profits from reducing income and excess profits taxes, but did object to giving the commissioner power that "may be used to circumvent the courts and indeed the Supreme Court which has upheld the principle that a man's motive to avoid taxation will not establish his liability if the transaction does not do so." The Senate version strikes out this grant of power to the commissioner and makes other changes which IPAA describes as "a great improvement."

Other legislation in which oil has an interest includes the following:

S. 1122, by Sen. Ellender of Louisiana. Grants independent tire dealers exclusive right to retail motor vehicle tires. Senate Banking and Currency commit-

tee completed hearings last session, at which oil interests raised serious objection, but has yet to take action on the bill.

S. 702, by Sen. Kilgore of West Virginia. Proposes to put the government into large-scale research through the creation of an office of scientific and technical mobilization. Is opposed by oil company research experts (*see NPN Dec. 29, p. 12*) but has not yet emerged from committee.

SM 1234, by Sen. O'Mahoney of Wyoming, and H. R. 3209, by Rep. Randolph of West Virginia. Substantially identical measures which would embark the federal government on a $30,000,000 experiment in commercial-scale manufacture of synthetic liquid fuels from coal, oil shale and other substances. Pending on House calendar and due for early action. See third column of this page for detailed story.

Besides the above specific measures, Congress will give active consideration during the new session to the development of a foreign oil policy for the U. S., as proposed by members of the Truman Committee, with the prospect that this may emerge as one of the big issues before many weeks.

The Truman Committee also plans an early report on its investigation of the army's Canol project—a report that is expected to blast the project as a "gigantic boondoggle." The House naval affairs committee will give consideration to legislation that may or may not authorize the Navy to enter into a contract with California Standard for unit operation of the Elk Hills reserve.

The Lea oil investigating subcommittee of the House also expects to be active, in view of requests from the Eastern Petroleum Importers Conference and other interests for opportunity to be heard on several phases of the oil war operation, including PAW's administration of Directive 59 and PAO 5.

Filling Of Little Big Inch May Start This Week

NPN News Bureau

WASHINGTON — If tests on the remaining 2 of 10 sections on the western leg of the Little Big Inch can be completed in time, plans are to start moving the first tender of heating oil into the line at the end of this week.

Assembling of the tender for delivery to Beaumont, Tex., started Dec. 29, and was to be moved into the line behind a slug of 150,000 bbls. of gasoline, which will act as a buffer between the heating oil and the tail-end of the water fill.

Water testing in the line east of Norris City, Ill., to the Ohio River and in the vicinity of Lancaster, Pa., is now under way.

Profiles in Oil

Schoenbaum Shifted to Key Job on W. Coast

Assignment of Maj. George H. Schoenbaum to the key post of chief of the West Coast petroleum suboffice at San Francisco was announced last week by Brig. Gen. H. L. Peckham, Chief of the Fuels and Lubricants Division of the Army Service Forces.

As chief of the sub-office, Maj. Schoenbaum will be in charge of all procurement and supply of petroleum products, except aviation gasoline and aviation lubricants, for armed forces in the Pacific theater of operations. His predecessor in the San Francisco post was Maj. Wiley H. Butler, who has been given another assignment.

Maj. Schoenbaum

Maj. Schoenbaum has been assistant chief of the operations branch of the fuels and lubricants division in Washington.

In private life a chemical engineer for Standard Oil Company of New Jersey, he has been in uniform for the last four years. He entered the service as a lieutenant in the ordnance department, where he was in charge of gasoline, grease and lube oil specifications, and the development of lubrication equipment and specialized equipment for use with petroleum products in the field.

Transferring to the petroleum branch when that unit was set up in the office of quartermaster general, Maj. Schoenbaum, as chief of the purchase section, operations branch, and, coincidentaly, as assistant chief of the branch, played a vital part in rounding up products during the early days of the war when procurement was such a critical problem.

Maj. Schoenbaum's headquarters in San Francisco are at 15th and Clay Sts.

Speedy Approval Seen On O'Mahoney's Oil from Coal Bill

NPN News Bureau

WASHINGTON — Final action is scheduled soon after Congress reconvenes Jan. 10 on legislation which would embark the federal government on a $30,000,000 experiment into the commercial-scale manufacture of synthetic liquid fuels from coal, oil shale and other substances.

Barring last minute and presently unexpected opposition, little difficulty is anticipated by proponents in obtaining early congressional approval of one or the other of two bills now pending on the House calendar. The bills are S. 1234, introduced by Sen. O'Mahoney, of Wyo., and passed by the Senate on Nov. 9, and H.R. 3209, introduced by Rep. Randolph, of West Virginia, and approved by the House Committee on Mines and Mining on Nov. 1.

While both measures are substantially identical, because of language changes by the Senate for the purpose of protecting against government invasion of the field of private enterprise, it is likely that the O'Mahoney bill will be the one considered by the House.

Presidential approval of the legislation is regarded as certain, inasmuch as it is sponsored by the Department of the Interior and the program it authorizes has been endorsed by the Budget Bureau as a postwar project. An Interior Department spokesman told NPN this week that, while Interior regards the Senate amendments as unnecessary, it has no objection to them.

Purpose of the O'Mahoney-Randolph bills, on which extensive hearings were held here and in Pittsburgh, Pa., Salt Lake City, Utah, and Sheridan, Wyo., is to take experiments already conducted by the Bureau of Mines out of the laboratory stage and into the demonstration stage.

In all the hearings conducted by the Senate and House, "Only one doubt was expressed," concerning the legislation, according to Sen. O'Mahoney and Rep. Randolph in the reports they submitted to the Senate and House. That was "That the authority contained in the bill might be used to put the government in competition with private industry."

Deny Threat to Business

Sen. O'Mahoney and Rep. Randolph both denied categorically this was either their intention or that of the Interior Department, the former asserting that the purpose of the legislation was merely to conduct experiments and pointing to amendments made in committee which made clear, he said, that, "the purpose is not to invade the field of commercial production at all."

"The only question," Sen. O'Mahoney said, "is whether or not we intend now to take time by the forelock and provide that the United States shall not in any

circumstances run short of a sure supply of fuel."

From Sen. Danaher, of Connecticut, came the charge during Senate debate, nevertheless, that the bill "collides head-on with everything the government has always stood for with reference to the rights of individual citizens."

Sen. Austin, of Vermont, also challenged the provision of the legislation authorizing the Secretary of the Interior, "to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this Act."

Although O'Mahoney cited other language requiring disposition of any surplus products through regular commercial channels as proof that, "the purpose is not to invade private rights," the Vermont senator called this provision, "entirely inconsistent with opening the door of this scientific research to private industry because private industry must come on bended knee, and must yield to what the Secretary of the Interior considers to be the appropriate terms upon which the licenses shall be granted. To my mind that is the highest form of control outside of complete exclusion from the field."

Important Changes Made

Upshot of the Danaher and Austin comments was that the Senate made several important amendments in the bill, all with O'Mahoney's approval or at his instigation.

One, by Sen. Austin, struck out the patent language for new language which, as he described it, keeps open the door to private enterprise for all discoveries made or processes developed as a result of the Bureau of Mines experiments.

Another, by Sen. O'Mahoney, was for the purpose of eliminating all doubts that the purpose of the bill, "is to enable the Interior Department to conduct the operations without invading the field of private enterprise." It struck from the measure language exempting the department from the restrictive provisions of certain laws already on the books and substituted a provision placing a five-year limitation on the U.S.B.M.'s experiments.

Early Start Claimed

According to Bureau of Mines Director R. R. Sayers, if the enabling legislation is enacted, the Bureau contemplates a request to Congress this year for the necessary funds to conduct laboratory research and development work which will determine the best demonstration plants to produce synthetic liquid fuels. Work, he said, would be started as soon as the appropriation becomes available.

The Bureau's program, he added, contemplates—(1) the Bergius process for the direct hydrogenation and liquefaction of coal; (2) the Fischer-Tropsch process for the production of synthetic liquid fuels from coal or lignite; 3. the low-temperature carbonization of coal in conjunction with either process 1, or process 2; and (4) the distillation of oil shale.

Steuart Penalty Increased After Double Appeal Hearing Before OPA Hearing Administrator

NPN News Bureau

WASHINGTON—L. P. Steuart & Bro., local fuel oil dealer, is ordered to cut off deliveries of fuel oil to customers acquired after Oct. 21, 1942, under an order issued Dec. 31 by OPA Hearing Administrator Talbot Smith.

Decision was rendered on a double appeal by OPA and the Steuart company from a suspension order issued Nov. 8 by Hearing Commissioner Clifford Snyder. The earlier order made the "no new customer" ban effective July 1, 1943; the present suspension rolls back the cut-off date to the beginning, rather than the end, of the 1942-43 heating season.

Upholds OPA's Appeal

In ordering this modification, Administrator Smith upheld OPA's appeal, which charged that during the first winter under rationing Steuart "intentionally disregarded the regulations with the view and purpose of increasing its fuel oil business." The appeal, filed by District Enforcement Attorney John Laskey, asked that the company be deprived of this increased business in order to "make it clear the business secured by illegal methods will not be preserved to a violator."

Renah F. Camalier, attorney for L. P. Steuart & Bro., told NPN that the company plans immediate appeal for an injunction to U. S. District Court, on grounds of unconstitutionality of entire OPA administrative hearings procedure.

Must Make Accounting

The suspension order, which is to be effective from Jan. 15 to Dec. 31, 1944, also requires the Steuart company to account to OPA by the end of January for all fuel oil transferred or received, and all coupons, ration evidences or delivery receipts received or surrendered by them from Oct. 22, 1942 (the beginning of the rationing program) till the date of accounting, and the quantity of fuel oil, coupons and ration evidences on hand and on deposit as of the date of accounting. The company is also required to provide the OPA district office a verified list of consumers served between Oct. 21, 1941, and Oct. 21, 1942, and to surrender all void or expired ration evidences in its possession.

Terms of the order provide that if at any time the Petroleum Administrator for War finds that the needs of the Washington area cannot be met from the facilities of other suppliers in addition to those of L. P. Steuart & Bro. as restricted by the order, and the OPA district director concurs in his finding, the order may be lifted "to the extent such action is shown to be necessary to the welfare of the community or the war effort."

Finds On 3 Charges

Where the Nov. 8 suspension order found Steuart guilty on only one of the three charges brought by OPA, resolving in the company's favor a "doubt" found to exist on the other two, the hearing administrator found the evidence sufficient to establish violation on all three charges—receiving deliveries of fuel oil without surrendering ration evidences, and failure to keep records on transfers in accordance with the requirements of the rationing regulations.

Summarizing the evidence, Administrator Smith declared that the Steuart company "violated the rationing regulations in every important respect," and continued:

"In defense and in mitigation, the respondent takes the singular position that it conceived its first duty to be the supplying of its customers with oil and that conformity with the requirements of the rationing system was subordinate thereto. . . . The philosophy expressed, if sound, is equally applicable to other persons and to other enterprises. In fact, the young businessman with his induction notice could in equal logic reply that his duty to his customers came first and conformity with the requirements of the Selective Service Act second. . . . The respondent's practice of putting its customers first and its wartime obligations later can neither be condoned nor excused."

OPA Philosophy Given

In forbidding Steuart to take on new business, while permitting the company to continue to serve customers on its lists before the beginning of rationing, Administrator Smith follows the line of several recent fuel oil suspension orders. Philosophy behind this type of order, according to OPA, is that if a supplier finds himself too busy to comply with the rationing regulations it is better to pare his volume of trade down to a size he can handle properly rather than to close his business entirely.

Among recent cases in which this type of suspension has been ordered are those of Steuart's supplier, The Petrol Corp. of Philadelphia, suspended Aug. 1 from adding any new accounts until May 31, 1944, and Arrow Petroleum Co., Chicago, placed under a similar ban for six months beginning Nov. 15. Chief grounds for Petrol suspension order was the charge that Petrol had delivered oil to L. P. Steuart & Bro. without collecting ration evidences.

OPA Stands Pat on Penalty Of 'No New Business'

NPN News Bureau

WASHINGTON—Appeal of Arrow Petroleum Co., Chicago fuel oil dealer, for modification of suspension order forbidding company to take on any new customers for six months in period beginning Nov. 15 was denied Dec. 22 by Joseph Harrison, acting hearing commissioner of OPA Region 6, NPN learned here this week.

Appeal raised question of whether a company operating under a "no new

business" type of suspension order, if it lost a substantial number of its old accounts, might be permitted to acquire new ones. Decision, however, did not settle the point, as appeal was denied on grounds that Arrow had offered only "conjecture" instead of figures on actual losses, in gallonage and in dollars and cents, to support its contention that annual turnover of accounts would create such severe hardship as to threaten its ability to continue in business.

Commissioner Harrison's comment, however, indicated that, while "a degree of hardship" would not in his opinion be ground for relief, "unusual difficulties", established by "clear proof", might be considered.

DSC Compensation Revised for Dist. 3 Crude to East

NPN News Bureau

WASHINGTON—Revised schedule of amounts per bbl. DSC will pay on shipments of crude from Dist. 3 origins to East Coast, in compensation for abnormal transportation costs, was announced Dec. 31 by DSC Vice-Chairman George Hill as follows: (amounts in c per bbl.)

Texas Panhandle, 31.5; West Texas and New Mexico, 26; West Central Texas, 29; North Texas, 31.5; East Texas (including East Central), 14.7; Talco area, 26.5; North Louisiana and South Arkansas (including Cass County, Texas), 19.6; Tinsley area (Miss.), 19.1; Central Louisiana, 15.1; Southwest Texas, 14.1; Texas and Louisiana Gulf Coast, 12.6; Southeast Louisiana, 8.3; Oklahoma, 31.5.

Oil Distributors In 3 States Termed 'Locally Needed'

NPN News Bureau

WASHINGTON—Following industry surveys of petroleum products distribution manpower in Oregon, Washington and Northern California, WMC state directors have declared petroleum distributors "locally needed" in these areas, NPN learned Jan. 3.

The designation affects distributors down to but not including service stations.

The designation will protect distributors from worker "raids" by other industries in the area where labor is now critically short. Another benefit will be the assistance given by local USES offices in recruiting workers for the industry to replace those who have been drafted, or who have shifted to essential or critical industries.

East Coast Stocks Increase, Remain Far Below Normal

NPN News Bureau

WASHINGTON—Despite a rise from 63,600,000 bbls. to 65,362,000 bbls. in east coast stocks of principal petroleum products during week ended Dec. 25, PAW Ickes warned this week that the Atlantic seaboard states are starting the New Year with these inventories still far below normal.

PAW MODIFIES PAO 11 RESTRICTIONS

(*Continued from p.* 3)

capacity of the nation, but should slow down the rate of decline.

Salient features of the new order, which will primarily affect operations in multi-zoned fields (those in which oil is found in various horizons at different depths) are as follows.

1. In drilling for oil on sectionalized land within two miles of any other drilling or producible well, the well shall be located on the quarter-quarter section within 150 feet of the pattern-well location, and at least 300 feet from quarter-quarter section lines.

2. The minimum distance requirement between wells on 40-acre spacing has been reduced from 990 feet to 900 feet, which will provide greater flexibility to operators in locating wells on the drilling unit.

3. Unless specifically prohibited by an exception or supplemental order, any well may be reworked or plugged back and recompleted in a shallower pool penetrated by the well. This provision applies throughout the U. S. except in California, where the conditions under which wells may be reworked or plugged back are covered by Supplementary Order No. 4 under PAO 11.

4. Any well may be deepened and recompleted in a deeper pool if the well, with respect to the pool or pools in which it is recompleted, conforms to the quarter-quarter section or 40-acre spacing requirements of the order, except that a pattern location need not be followed.

5. Pumping or other artificial lifting equipment may be installed in wells which have been deepened to lower pools pursuant to the order, and it may be interchanged in its entirety between wells on the same lease. Additional tubing or sucker rods may be installed on any pumping well.

6. Condensate fields are included within the newly-defined term "restricted area." Drilling of all wells in "restricted area" must be by exception unless commenced prior to designation of the area as a "restricted area."

7. Gas-gathering systems may be constructed, provided material cost does not exceed $5,000 and existing facilities are not duplicated.

ODT Reveals Distribution of 1st Quarter 'Gas'

NPN News Bureau

WASHINGTON—Distribution of gasoline among automobiles, trucks and other transportation facilities was revealed for the first time this week when ODT announced the number of barrels per day each type of transportation will receive out of the amounts allocated for the first quarter of 1944 by PAW.

The allocations for passenger cars, ODT Director Eastman said, are based upon an ODT estimate that the essential transportation work of the automobile can be performed with an average mileage for the nation of between 5000 and 5500 miles a year. The average annual mileage before the war, he added was about 9000 miles, of which about 4000 was for social and recreational driving.

Allocations of gasoline for passenger cars vary considerably among the five districts since individual dependence upon the automobile varies because of such factors as availability of public transportation facilities, distribution of population between urban and rural places, and distances to be traveled, Mr. Eastman explained.

Thus, he added, it has been determined that the essential needs for automobile transportation can be met with an average annual mileage of about 4800 on the Atlantic Seaboard and an average of about 6500 miles in the Southwest. The averages for other sections range between these figures.

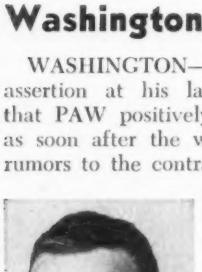
The ODT's distribution of district allocations among the different classes of transportation facilities for the first quarter compared with the fourth quarter of 1943, in number of bbls. daily, is as follows:

PAW District	Passenger Cars	Trucks	Local Commercial Passenger Transportation & Intercity Busses	Water Transportation	Railroads	Total
ONE						
1st Quarter	178,959	123,797	37,818	66	350	341,000
4th Quarter	175,600	135,400	38,510	70	420	350,000
TWO						
1st Quarter	225,244	126,473	21,971	37	275	374,000
4th Quarter	233,900	138,100	22,600	50	350	395,000
THREE						
1st Quarter	64,362	51,174	7,208	7	249	123,000
4th Quarter	63,500	56,100	7,090	10	300	127,000
FOUR						
1st Quarter	15,194	11,241	1,439	0	126	28,000
4th Quarter	16,240	12,250	1,360	0	150	30,000
FIVE						
1st Quarter	79,505	33,372	4,858	16	249	118,000
4th Quarter	77,920	36,620	5,140	20	300	120,000

PIPELINES—*Views of the Industry's Problems*

Washington— *PAW To Disband, but What Will Follow?* —By Herbert Yocom

WASHINGTON—Secretary Ickes' flat assertion at his last press conference that PAW positively will be disbanded as soon after the war as possible—"all rumors to the contrary notwithstanding" —can be taken at face value. He meant exactly that.



Mr. Yocom

We're not so sure, however, about his further statement to the effect that he envisions NO necessity for any form of Government control over the oil industry in the postwar period. The reason we're not so sure is that we have reason to believe that there are schemes afoot right now in Mr. Ickes' Department of the Interior which:

1. If realized, will result in placing the government in direct competition with the oil industry after the war, and

2. If carried to their logical conclusion, may be expected to develop into a New Deal or "Win-the-War" Party movement for a complete nationalization of oil.

These are strong statements. They may be denied, and they should be if they have no foundation in fact. It is significant, however, that there has as yet been no refutation by Secretary Ickes of the following item published in Platt's Oilgram of Dec. 10:

"Secretary Ickes, in conferences with high ranking administration officials, including Army and Navy, is vigorously plugging for formation of a government-owned corporation to take over all development drilling on public domain and also to take over and develop naval reserves. Argument he is using is that oil situation is so desperate and critical that only by government entrance into producing business on public lands can a disastrous crisis in oil be averted."

Likewise significant is the fact that he has not so far chosen to challenge the accuracy of a report carried in a November issue of the *Wall Street Journal* to the effect: "Government competition in the oil business is Ickes' new postwar aim."

"He spilled the beans in a secret session on Capitol Hill, but hostile Congressmen are circulating the news," ran the Journal's account, adding: "Ickes wants: A Government agency to pump oil from the national reserves, instead of leasing them to private industry; continued control of refineries built with government funds for war use; government operation of the pipelines and tanker services war-financed by Uncle Sam. Some Congressmen say it is the same technique used by the New Deal to muscle in on the electric power business. . . . "

There is solid substance in both these reports. They ought to be looked into now by PIWC and the industry generally.

* * *

Justice Digs at PAW

The oil industry should be on the watch for a new exchange of letters between Justice and PAW restating the scope and nature of PAW's powers and more clearly defining the authority of industry committees appointed by PAW.

The exchange, which is now in process, is the result of a long inquiry by Justice into the activities of various industry committees — an inquiry which has led that department to the conclusion that PAW has been delegating too much right of independent action to those committees. Cited by Justice officials as outstanding "horrible" examples of what they now want corrected are operations by industry under Directive 59, providing for pooling of supplies in District 1, and under Recommendation 19, on California production.

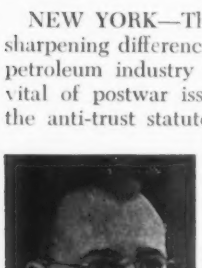
* * *

Washington Gossip

Talk in Washington now is to the effect that there appears little chance for retention in the new tax bill of the Senate Finance Committee's amendment which exempts from renegotiation all government contracts and subcontracts for all petroleum products identical with those sold for general civilian, industrial or commercial use prior to Jan. 1, 1940. . . . . Decline of motor gasoline stocks in U. S. has averaged from 30-35,000 b/d during the past two years . . . Seriousness of District 5 position is indicated by fact that California stocks of all oils have been dropping off at rate of at least 4,000,000 barrels per month in recent months, and that the November decline probably was between 5-6,000,000 barrels. . . . Reason prompting PAW Ickes' statement Dec. 28 that District 1 refiners must blend their premium and housebrand gasoline "as closely as possible" to the 76-octane and 72-octane numbers required by wartime specifications is said to be that some refiners were blending house brand only to around 69 octane . . . PAW is extending its forecasts of U. S. productive capacity and discovery rate through the year 2020. Most recent forecast was projected only through 1965.

Atlantic Coast— *Oil Industry Divided on Postwar Anti-Trust Truce* —By Henry Ozanne

NEW YORK—There appears to be a sharpening difference in viewpoint in the petroleum industry on one of the most vital of postwar issues—to what extent the anti-trust statutes should be relaxed in the era of reconversion and reconstruction.



Mr. Ozanne

While this question is important for every industry, it is probably more crucial for oil than for any other sector of the American economy, due to two determinant factors, the extent to which the industry has been exempted from anti-monopoly legislation during the war, and the vast technological developments of the war years. To date the petroleum industry has been granted more wartime certificates of immunity from anti-trust legislation than any other industry, excepting transportation. This has been accomplished under a rider to the Small War Plants Act of 1942 authorizing the chairman of the War Production Board to grant immunity from both the anti-trust laws and the Federal Trade Commission Act when in his belief such action is necessary for the war effort.

By the end of 1943 almost 150 grants of immunity had been made by WPB Chairman Nelson and the cumulative effect of those granted to the petroleum industry is such as virtually to change the industry in respect of U. S. Department of Justice policy. PAW Ickes, who largely has been responsible for the freedom of operation won by the industry, already has been criticized by many trust-busters, and the oil industry is likely to be under special fire when the question of monopoly restraint arises at the close of the war.

A large portion of the industry is definitely in favor of relaxed anti-trust control in postwar America. The Roosevelt administration's plan for a two-year period of such leniency has been at least passively supported by this group in the industry. Oil has been represented at the Baruch Planning Committee hearings, and headway has been made in orienting both the committee and the Justice Department to the view that industry-wide agreements may be absolutely necessary to protect the technological stake of the industry. There is the further consideration, that without such

...Reflected by NPN Writers at Three Vital Points

agreements the whole national economy might veer toward chaos in the change-over to peacetime, civilian production.

In fact, generally it is the industry's belief that it should have a share in the determination of the quantity and quality of its postwar product—for instance, how much 100-octane gasoline should be produced for air and ground transport facilities that can be utilized at the close of the war.

Quite different, apparently, from the view for relaxation of anti-trust legislation is the one held by J. Howard Pew, Sun Oil Co. president. In a statement issued on Dec. 31, Mr. Pew said: "The industry, by and large, wants no relaxation of the anti-trust laws, nor any immunity from either the spirit or intent of this legislation, either now or in the postwar period."

Mr. Pew also expressed himself against cartels, taking much the same position previously championed by the Standard Oil Co. (New Jersey) which repeatedly has opposed national and international tieups of trade. Jersey's president, Ralph W. Gallagher, recently said: "I oppose cartels so far as our company is concerned in any place with all the vigor I have." (*see NPN, Sept. 15, 1943, p. 8*). Standard Oil itself issued a statement last Sept. 14 saying: "We do not believe in controlling production—whether it be done by bureaucratic expedient or by businessmen behind locked doors or board rooms. We do not believe in combinations to control prices. . . . We are against secret agreements."

The position taken by Mr. Pew and Jersey Standard comports with the policy of the Justice Department which is irreconcilably opposed to cartels.

Interesting in this connection for the oil industry is the administration's foreign oil policy. Petroleum Reserves Corp. might easily become not only "an international cartel" but a government-controlled one as well. This is the warning of the PAW committee on foreign operations, advising PAW Ickes against foreign oil deals. Mr. Ickes told his press conference Dec. 30 that he did not feel government control over the industry should extend to the postwar period, but he was not so definite about government foreign operations. (see OIL-GRAM, Dec. 30)

It appears, then, that all three branches of the government are now favorable to a relaxation of the anti-monopoly laws for some brief period after the war. But the bars won't be let down completely. That leaves the industry with the problem of how to effect industry-wide arrangements, how to initiate and maintain cross-company discussion without fouling on the anti-trust statutes.

Reconversion to a civilian economy, it is generally conceded, will demand some sort of planning, whether it be democratic or bureaucratic, government-imposed or industry-sponsored. Intelligent competition does not mean dog-eat-dog anarchy. Oil has a vital stake in the program to follow, but so far the voice of oil has not been strongly heard. One reason, apparently, is that the oil industry, as yet, is not unified in its own thinking.

Mid-West— *Closer Well Spacing Would Ease Oil Shortage* —By Earl Lamm

CHICAGO—Since more crude oil is the urgent need of Dist. 2 refiners, just what is the inside story on production and what can be done about it?

Opinion may differ somewhat on the cure — the methods to be used and the relative effectiveness of each—but everyone agrees on one point—total production for the district is declining rapidly! Average production for December was 915,000 b/d, which is a 9% loss during 1943, and if that rate continues through 1944, production of the district will be down to 820,000 b/d by next December.

Mr. Lamm

Dist. 2 is the only one of the 5 PAW districts showing any appreciable decline in production. The graph line for Dist. 1 is flat. Dist. 3 is on the increase because of higher withdrawals and will probably maintain at least the present rate. Dist. 4 increased this year and is due to increase further due to the Elk Basin field in Wyoming. Dist. 5 has increased from 619,000 b/d in 1942 to 800,000 b/d at present, and the state of California will probably produce more oil in 1944 than in 1943, due to price increase already granted and more liberal well spacing regulations, which is causing drilling up of all old fields.

In Dist. 2, the only sick unit in the whole PAW set up, there is some feeling that PAW, and WPB, Washington, have worked too closely with the major companies in throwing effort and material into the West Texas sour crude basin, to mention only one area. Some of the material and attention can be directed elsewhere to better and more speedy effect.

PAW recently has been fairly liberal in granting exceptions to well spacing regulations—but the regulations are still there and should be reduced or removed entirely and the authority returned to the various state regulatory bodies, which have long governed conservation. For instance, the 50 Mid-West and Mid-Continent refiners who met at industry headquarters here last week, seeking more crude, estimated that relaxing PAW well spacing regulations would produce an additional 30,000 b/d of crude from new wells that then may be drilled in Dist. 2.

A conservative production man has since declared that the state of Kansas alone could produce that much—and would be producing 100,000 b/d more than at present by the end of 1944 if restrictions were lifted now so that drilling can get under way. Dist. 2, he said, is now drilling only 60% of the number of wells being drilled before restrictions were placed on activities, but the number of dry holes is the same for the 60% as it was for 100%; that is, the number of dry holes has increased 40%. Reason is, 1320 ft. well spacing (1 well to 40 a.) is not recognizing reservoirs that exist east of the Mississippi, in Illinois, Kentucky and Michigan, where the porosity is streaked or irregular and where the fields are narrow.

Relaxing well spacing regulations from a 40-acre to a 20-acre pattern for lime drilling in Illinois, and from a 20-acre to a 10-acre pattern for sand drilling below 2500 ft., will increase the state's production 25,000 b/d according to a very conservative estimate, although Dr. M. M. Leighton of the state geological survey placed the figure at 100,000 b/d recently.

Production in the Reed City field, Michigan, was reduced at the December hearing from 18,000 b/d to 14,000 b/d upon the testimony of two professors from the university, in the face of urgent testimony to the contrary by the operators, who wanted spacing regulations relaxed from a 40-acre to a 20-acre basis so they could drill 30 additional wells. These wells at 125 b/d per well allowable (the present rate), would add 3750 b/d to production of the field, making it 21,750 b/d instead of the present 14,000 b/d.

By going to 20-acre spacing in proven territory in western Kansas alone it is estimated that 1300 new wells would be drilled which would produce 75,000 b/d.

What would happen by relaxing spacing in the many fields of Oklahoma is as yet an unknown quantity as no estimates have been made, but the result would be considerable and there are other highly important considerations.

Adding up what we have already—100,000 b/d for Kansas, 25,000 b/d for Illinois and 3750 b/d for Michigan, totals 128,750 b/d, which is enough to fill more than half of the 205,000 b/d idle refining capacity now in Dist. 2. In drilling of those wells in proven territory, results are reasonably sure. No wildcatting is taken into consideration.

The Week's Orders

(Issued Dec. 25, 1943 - Jan. 1, 1944, inclusive)

OPA—Office of Price Administration

Prices

GMPR, SR 14, Am. 69—Ceilings on reconditioned and used valves

Interpretations

General Interps.—Tying agreements
RPS 63—New tire and tube prices
RPS 66—Fire-damaged new tires and tubes
MPR 107—Fire-damaged new tires and tubes
MPR 119—Solid rubber tires (original equipment)
MPR 143—Solid rubber tires (wholesale)
MPR 149—Rubber separators in electric storage batteries
Overtime charges
RPS 88—Drawing oil; gasoline prices last half 1943

Rationing

RO 1A, Am. 64—Reconstruction Finance Corp. transfers
RO 5C, Am. 94—Rations for convalescent servicemen
RO 11, Supp. 1, Am. 8—Value of coupons numbered "3"

WPB—War Production Board

Orders

L-134—Restrictions on valves and regulators
P-43, Direction 1—Laboratory report no longer required
R-1, Am. 2—Changes in Regulations as to Manufacture of Rubber Products
Appendix III, as am. 12-29-43—Additions to prohibited list
U-1-a—Extensions of gas facilities for military purposes
U-1-d—L-41 construction allowed gas connections
U-1-f—When gas facilities may be extended

Regulations

CMP 9A, Direction 1—Copper tubing for repair of heating equipment
Interpretation 1—What constitutes repair parts
Pri. Reg. 11B, as am. 12-21-43—Production materials for products neither Class A nor B
Pri. Reg. 18, Direction 1, revocation—Compressor and heat exchanger order deadline revoked

Executive Orders

EO 9409—War Manpower Commission makeup altered
EO 9410—Selective Service Director's powers increased

Foreign Economic Administration

Gen. Regs., Am. 128—Prohibited exportations—asphalt

Digest of Week's War-Oil Orders

Office of Price Administration

CEILINGS ON RECONDITIONED AND USED VALVES—GMPR, SR 14, Am. 69—After 12-29-43 the following ceilings apply to reconditioned valves and used valves, regardless of prior agreements: Reconditioned valves—80% of original manufacturer's net f.o.b. price to jobbers (published list price less "J" sheet discount) for new valves (or of other manufacturer's net jobber's price for identical new valve); used valves—40% of same base price. "Reconditioning," defined as complete disassembly, examination, replacing defective and worn parts, reassembly and painting, and hydrostatic test at double the rated water working-pressure must reveal no defects. "Used valve" defined as a valve incorporated into or connected to a piping system, machinery, or operating mechanism, which valve has not been reconditioned. Cash discounts operative during March, 1942, apply now. Sellers must tag all reconditioned valves with special guarantee. Installed sales of reconditioned or used valves governed by a special price regulation, not GMPR. All sellers must retain records available for OPA inspection, and must notify purchasers, at time of initial purchase, as to existing ceilings. Issued 12-22, effective 12-29.

TYING AGREEMENTS—Issued 11-5, released 12-14—Purchasers of "frozen" commodities cannot be required to buy combinations of commodities if not required to do so during base period, as this constitutes a tying agreement. As to regulations other than "base period freeze regulations", any arrangement conditioning the sale of one commodity upon the purchase of another is a tying agreement, and therefore a violation.

SOLID RUBBER TIRES—PS 63—PS 63 covers retail sales of new solid and pneumatic rubber tires if such tires are for types of vehicles listed in PS 63. Wholesale prices are determined by MPR 143, and original equipment ceilings by MPR 119.

FIRE-DAMAGED TIRES AND TUBES—New rubber tires include those used less than 1000 miles, even though damaged by fire, water, and smoke. If sold "as is" by the retailer, PS 63 governs; if retreaded, PS 66 applies. MPR 107 (Used Tires & Tubes) is inapplicable, even if damaged tire is repaired as therein provided.

TYING AGREEMENTS — Conditioning the sale of a tube upon the purchaser's buying a tire is a violation.

RUBBER SEPARATORS FOR BATTERIES—MPR 149 governs separators for electric storage batteries, under heading "all other mechanical rubber goods, except those listed in Appendix A".

SPECIAL SERVICE CHARGES—Extra expenses incurred by mechanical rubber goods manufacturers to oblige customer, such as overtime labor, machinery starting during week-end closedown, etc. may not be added to regular charge, even though such additional charge does not exceed actual cost of special service.

PRICES WHERE NEOPRENE SUBSTITUTES FOR RUBBER—If on base date the rubber portion of any item was made of natural rubber, the price does not apply to present article made from neoprene, and Sec. 1315.21a (a) (a) (iii) governs. (MPR 149)

INTERPRETATIONS RPS 88—Drawing oil (10% mineral oil, 50% fish oil, 40% lard oil) not covered by RPS 88, as it is not an industrial lubricating oil within RPS 88's meaning.

Ration allotments of gasoline—Consumer's ration allotments as of 7-1-43 control price he pays during last half of 1943 (Sec. 1340.159 (b) (11) (iv) and (v)), even though actual amount delivered varies from allotted amount because of subsequent changes in ODT ration allotments.

Price distinctions, reference seller—Sellers adopting price of reference tank wagon seller must also adopt the customary price distinctions maintained for various classes of purchasers by such reference seller. Issued 11-5, released 12-14.

RECONSTRUCTION FINANCE CORP. Transfers—RO 1A, Am. 64—Tire and tube transfers may now be made *by*, as well as *to*, Reconstruction Finance Corp. or its subsidiaries, without certificates. RFC must notify OPA Tire Rationing Branch in Washington, upon transferring tires or tubes to a dealer or manufacturer, as to name of transferee, amount, type and grade of tires and tubes, and destination of shipment. Dealers or manufacturers receiving scrap tires under this provision must notify OPA District Office within 10 days as to number received, and must not dispose of them for 30 days from date of notification, unless approved for disposal by an OPA tire examiner. OPA written authorization still required for other RFC transfers. Issued 12-23, effective 12-29.

SPECIAL RATIONS TO CONVALESCENT SERVICEMEN—RO 5C, Am. 94—A serviceman on leave convalescing from illness or injury acquired on active duty may obtain special rations for traveling to and from home, or a resort or other place of recuperation, upon presentation of leave papers to board, together with letter from medical officer certifying that automobile transportation will assist in recovery of applicant's health more materially than would other means of travel. Issued 12-31-43, effective 1-1-44.

VALUE OF "3" FUEL OIL COUPONS—RO 11, Supp. 1, Am. 8—In Zones A-1, A-3, B-1, B-3, C-1, and C-3, 1 unit on coupons numbered "3" on Class 4 coupon sheets shall be valued at 10 gal., 5 units on Class 5 sheets at 50 gallons, and 25 units on Class 6 sheets at 250 gal. of fuel oil. Issued 12-31-43, effective 1-4-44.

NPN will appreciate hearing from its readers if they feel any pertinent regulations have been omitted from this page.

Copies of the complete text of the following orders can be obtained from PLATT'S OIL-Law-GRAM, 1213 W. Third St., Cleveland, Ohio

Minimum charge for single copies, $1, postage paid. One year's service, $100.

CODE: AO—Administrative Order; CMP—Controlled Materials Plan; D—Directive; FDO—Food Distribution Order; GMPR—General Maximum Price Regulation; GO—General Order; Interp.—Interpretation; L—Limitation Order; M—Conservation Order; MPR—Maximum Price Regulation; P—Preference Rating Order; PAO—Petroleum Administrative Order; Pri. Reg.—Priorities Regulation; Proc. Reg.—Procedural Regulation; PS—Price Schedule; RO—Ration Order; RPS—Revised Price Schedule; SO—Supplementary Order; SR—Supplementary Regulation.

War Production Board

RESTRICTIONS ON INDUSTRIAL VALVES AND REGULATORS—L-134, as am. 12-23-43—Control valves and regulators for hydrogen fluoride service are exempted from provisions of L-134 restricting inner valve and seat ring construction. Issued 12-24-43.

LABORATORY REPORT REQUIREMENT ABANDONED—P-43, Direction 1—Serial-numbered laboratories no longer required to file quarterly reports (including the one due 1-1-44) on Form WPB-167 unless specifically so ordered by WPB. Issued 12-24.

CHANGES IN RUBBER RESTRICTIONS—R-1, Am. 2—Schedule A, Appendix 1 restrictions changed on manufactured products, so that certain automotive parts (remote control gearshift bushings, shock absorber bushings, and water pump seals) may now use crude rubber or latex only as required for Government order, subject to special authorization. As to hard or soft rubber linings for drums and tanks and pipe and fittings, individual applications (such as repair of existing linings, etc.) may exceed the 10% maximum of crude or latex, provided the total consumption of either for all applications for any given period does not exceed the 10% maximum. Issued 12-22.

R-1, Appendix III as am. 12-29-43—The special exceptions in Am. 2 to R-1 (above) permitting use of crude or latex in excess of 10% maximum for individual applications for drums, tanks, pipes, and fittings, limited to individual applications of following types only: (1) repair of existing crude or latex linings; (2) where sharp corners or angles requires; (3) for tie gum where vacuum is present; (4) for not more than 1/16" coating or ply over GPS lining to arrest penetration of hydrochloric, hydrofluoric, and phosphoric acids. Group 5 (Camelback) of List 6 (Tire & Tube Production Pattern) in Appendix II (Manufacturing Regulations) is defined as including repair materials in addition to camelback. Issued 12-29.

EXTENSION OF GAS FACILITIES PERMITTED FOR MILITARY PURPOSES—Supp. Utilities Order U-1-a, as am. 12-10-43—Total materials cost of such extensions must not exceed $1500 in underground construction, and $500 for other construction, both exclusive of any part built by or for consumer. Already installed adequate service must not be duplicated,

(*Continued on p. 42*)

The Editor's Page

PAW Can Do the Industry a Real Service by Discarding The Word "Marketing" and Substituting "Distribution"

NOW THAT PAW is reorganizing its divisions and changing the names of some, isn't it a good time for this official head of the oil industry to consider renaming the so-called "marketing branch"?

That word "marketing" is not exactly used accurately when applied to the distribution of oil. Public and Washington officials have seemed to consider "oil marketing" at times as more "selling" of petroleum even at fancy prices, than "delivering" to the users. Such false impression of the essential function of the owners of terminal, bulk plants and service stations, worked against the industry when it sought to have "marketing" declared an essential activity. Government officials put oil "marketing" in the same class as all other "selling" and "merchandising" and refused to see the "distribution" function that our "marketing" branch actually performs.

Like other termnology in the world, "oil marketing" just happened into use without any one giving much thought to what the word means or where its use might lead the public's mind. Originally, Standard Oil just "distributed" its products without any fancy selling or advertising. Then, probably, three ideas came together. The Independent owner of bulk plants wanted to get away from being known as a "jobber", which he decidedly is not according to the definition of all other industries, so he sought to rename himself "marketer" and in this NPN admits it had a hand.

That word "marketer" bobbed up when a group then called "brokers" were operating at their maximum in the oil industry with banks in the oil country and St. Louis and Chicago setting up all sorts of people in the business to get some of the then quick money. Most of these were fly-by-nights in every sense of those words. The men who were doing this wholesale selling for the small refiners on a legitimate basis and furnishing a necessary service to the industry, wanted to get away from the bad ones so they, too, got to calling themselves "marketers".

And about that time we had the big development in national advertising of oils and gasolines, so the larger companies hoisted the sign "Marketing Department" over their distribution facilities and every one seemed to be happy.

Then along came higher and higher-powered selling, more and more salesmen with elaborate portfolios of sales literature in all the colors, and multitudes of "sales meetings" and "pep" meetings where the new seasonal sales ideas were disclosed. We also had more and more bulk plants and service stations with a dozen and even a score of signs of as many different petroleum brands at a single station.

When this development had flowered then each "marketing department" began pointing to the other fellow's "marketing department" and calling the industry and, unfortunately, the public's attention to their criticism. This was to the effect that there were too many stations, too many signs, too much free painting of dealer outlets etc., etc., etc. It all boiled down to the idea that there was no profit in the "marketing" business because there were too many "other fellows" and they spent too much money dressing up their product and in frantic sales efforts.

The industry, with this idle and foolish talk and accusation, has done itself great harm in the last 15 years because the public believed it all and government would-be regulators had the industry's own admissions with which to start their attacks. These "economists" and professors and reformers and experts loudly proclaimed oil marketing inefficient and unnecessarily costly and in this too many "marketing" people in the oil industry, all wrapped up in the scenery of their activities, joined.

Always, the evidence of inefficiency was the "great number" of outlets. What the blind did not see and what the critics did not want to see, was that this "great number" was the very thing that the government, critics were demanding, towit: more and more competition that was evolving more and more efficiency for a tremendously swelling market. Also the critics refused to recognize that the number of these outlets was also increased by the constant floods of low-price crude oil from the continued discovery of the greatest oil fields in the world's history.

Things That Make for Efficiency, Lower Cost

Also these critics, including those within the industry, failed to see that the very national advertising, the dressing up of stations, the identifying of lube oils, the perfecting of fine and handsome equipment were in themselves bringing ever greater efficiency and lower cost. True, maybe one could point a finger to a sign here and a station there that did not make for greater efficiency in themselves. However, when many thousands of units are striving against each other in perfecting distribution on a national scale reaching into every village and hamlet, with new products that are radically improved every year, one cannot expect every single feature of the effort to seem efficient, especially in retrospect.

The unfortunate part of all this great development was that the critics and the highly competitive spirit centered on the outward signs of the merchandising of goods to such an extent that not only the public and government but also many in the oil industry saw the bright paint and numerous outlets and their multitude of signs rather than the distributing facilities themselves. Some in the oil industry thought that these more public outward signs were the only tools for making profits, regardless of the kind of equipment, where it was located and how well it was managed. These industry critics failed to see that the efficiency and low operating cost of good equipment well placed and properly managed was greatly accentuated by the use of these other sales tools when used to educate the public properly about these ever new and improving products.

The result of all this uncalled for criticism was that the word "marketing" stuck over the distribution division of the oil industry and the public took us at our word. They looked the word up in the dictionary and found that all of its shades of meanings tend more to describe the effort of selling, the effort to convince the unwilling buyer that this is what he wants even though he had not thought about it.

"Marketing", if the word experts will pardon, connotes more the prevailing on the human mind, overcoming its dislikes or lethargy, rather than suggesting getting a highly efficient product into the customers car at the lowest possible

READERS' comments and opinions will be much appreciated by Warren C. Platt, NPN's Editor and Publisher, Penton Building, Cleveland 13, Ohio.

cost, with the least fussing and being able to provide that product entirely at the convenience of the customer. "Marketing" has meant more the sales effort, than the whole distributing system.

When this war came along many in the oil industry were not particularly surprised that all of its divisions were not declared essential. Some of the people in "marketing" really agreed that the "other fellow" and his stations and dealers were "unessential." It was surprising also that the industry did not put up a better fight against this unfair and false classification for its distributing division. In fact it was not until the military draft and the call of war plants cut deeply into "marketing" personnel that the industry, as a whole, became alarmed.

It might also be added that a number of "marketing men" were surprised at the results of the surveys under PAW for joint use of distributing facilities, to learn that substantially all existing facilities and their employes are necessary to the efficient distribution of products. One such survey was actually started on the assumption that outlets below a certain gallonage could be dispensed with but when the survey was made it was found that some of these outlets were absolutely essential and that to have closed up "the others" in the name of efficiency would have been to have stopped small country store owners from handling gasoline which would have increased the overhead on their other lines and made them less efficient.

Men high up in oil "marketing" and also in PAW, have been thinking of this misnomer of "marketing" for some time. Back of the thinking of some, at least, in revamping the PAW committee set-up, is the discontinuance of the word "marketing" and substituting therefor "distribution".

That word "distribution" accurately and fairly describes what the oil industry does with its products when they leave the refineries. These products are sorted out in the very latest type of distributing facilities and put in the customer's tank whether at the back end of a passenger car, or in a manufacturing establishment. From the refinery to that ultimate customer the products are handled in various kinds of the most modern and efficient type of equipment that represents a capital investment well up to as much as the refineries themselves. The advertising and merchandising are just the handles by which employes in oil distribution can work these facilities easier at the lowest cost and move with practically no loss a highly volatile product with practically no inventory.

Does the industry realize that much of its product is made and distributed and consumed in the same week? That is not due to "marketing" or "merchandising" but to the whole distributing system that is well planned and maintained, that is properly managed and whose products—not the distributing system—have been well sold by marketing—advertising, merchandising, even before the products were made.

Distributing Takes in All Operations

This is not just a play on words, this difference between "marketing" and what it means to the general public and the industry's critics, and the word "distributing". Rightly or wrongly, "marketing" has come to mean mostly "selling" while "distributing" still means getting the products to the customer.

By switching to "distributing", or any other word that will serve the same purpose (we can't think of one right now) the oil industry will necessarily change its thinking. It will switch from thinking and talking of only a part of its effort to supply its customers, to envisioning all of its operations.

Such a change should help the industry see more clearly the simply tremendous investment it has in distributing facilities, a matter of billions of dollars. The change should cause the industry to view those facilities with an approving eye, and cause oil men to realize that the industry's vast distribution system is just as important and just as efficient as drilling wells and running refineries.

Because of the confusion of the keenest kind of competition, and because so many big executives came up from the oil fields or refineries, the tendency has been for many in the industry to look down upon oil distribution as being something almost apart from the industry.

On the contrary, the oil industry has just as much reason for being proud of what it has done in distributing its products at an insignificant cost, as it has reason for being proud of all the engineering by which it sinks wells 2 and 3 miles down, runs big pipelines across thousands of miles of all sorts of land, keeps tankers and barges moving over all the seas, and, in the great scientific skill with which it is now breaking up molecules at refineries by the untold trillion trillions into just the exact kind of a product that the general public needs and at a cost to that public of a fraction of a cent.

It also is highly desirable that the oil industry change its pace in thinking about the distribution of its products. With the ending of this war, the competition will be still greater because of larger and better engineered distributing facilities. Also more oil executives than ever will realize the importance of MANAGEMENT in directing all the thousands of details of oil DISTRIBUTION, details that you do not find in producing and refining and yet they are details, the proper handling of which, spells profit or loss. Likewise, in recent years a number of the major companies have learned what the Independent has known all along—that by close attention to the details of the distributing system, by better management of all that centers to the point of contact with the ultimate customer, they can make good profits out of their distributing divisions, more certain profits than speculating in wildcatting and producing. And these majors have learned that those profits come, not from raising to higher prices, but from steadily reducing costs by better operating methods so as to be able to make the profit on a strictly competitive price basis.

If there is any point to all this argument, it would seem that PAW could discard the word "marketing" entirely in favor of the word "distribution". Oil marketing associations and major oil companies could make the same switch in their names.

By so doing, the industry would be in better shape to meet the political and economic storms of the future because the true economic and necessary industry function of oil distribution would be more easily seen by both the public, the critics and ourselves.

Independents Should Ask OPA Headquarters For Protection Against its Employes

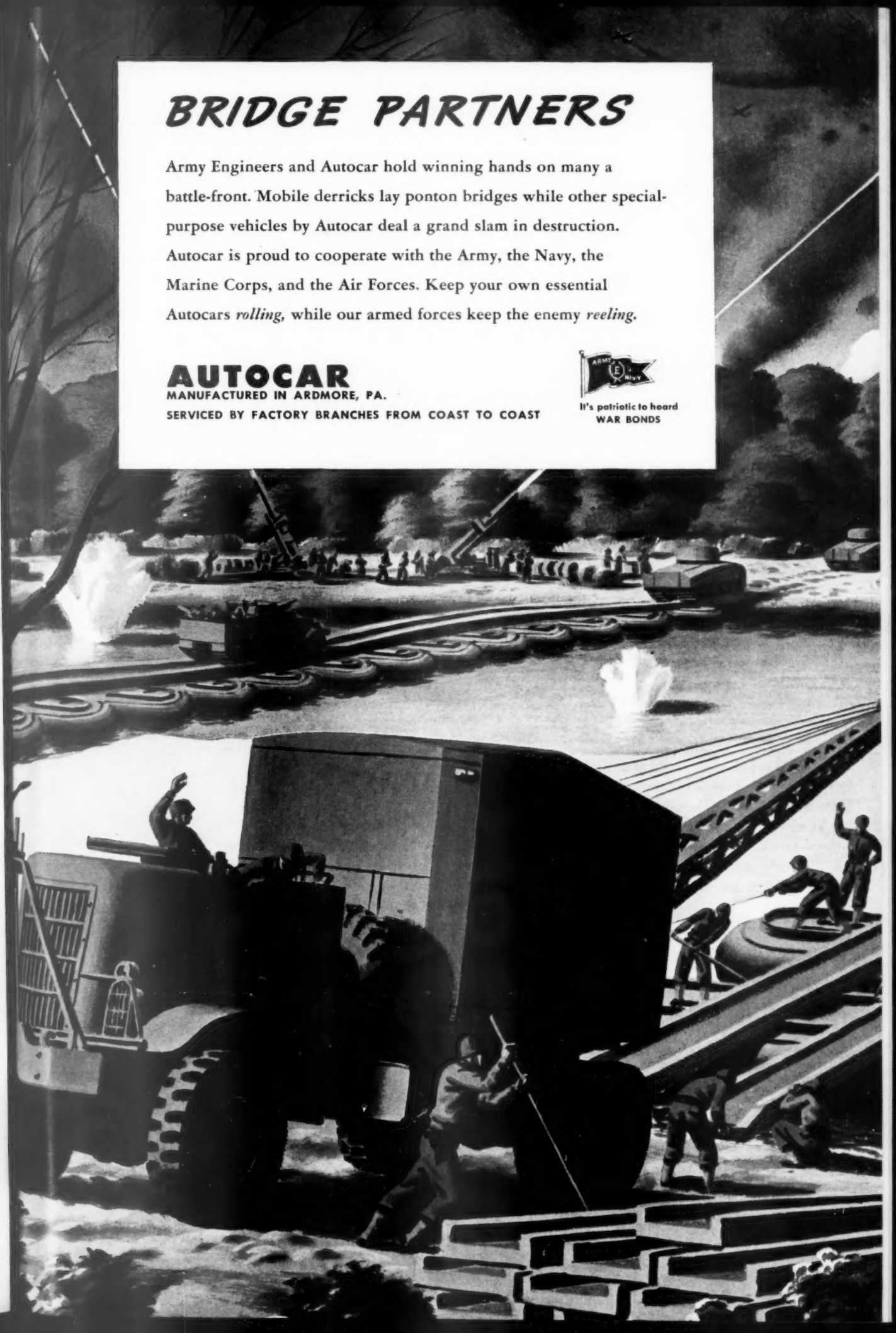
AS THE OPA campaign against counterfeit gasoline coupons gets under way it would be well if the associations representing the Independent marketers got from OPA headquarters at Washington a few clear and definite rulings on the following,—

1—Is it good law for a government agency, such as OPA, to hold a company liable for the violation of OPA rules by its employes in the absence of any evidence of guilt by the company?

2—If an average man exercising reasonable diligence in the ordinary course of business cannot identify a counterfeit coupon, will OPA hold the man or the company responsible for accepting that coupon, other than to have the company reject it as in the case of counterfeit money?

The OPA chief law enforcing attorney at Chicago has made

(*Continued on p.* 40)



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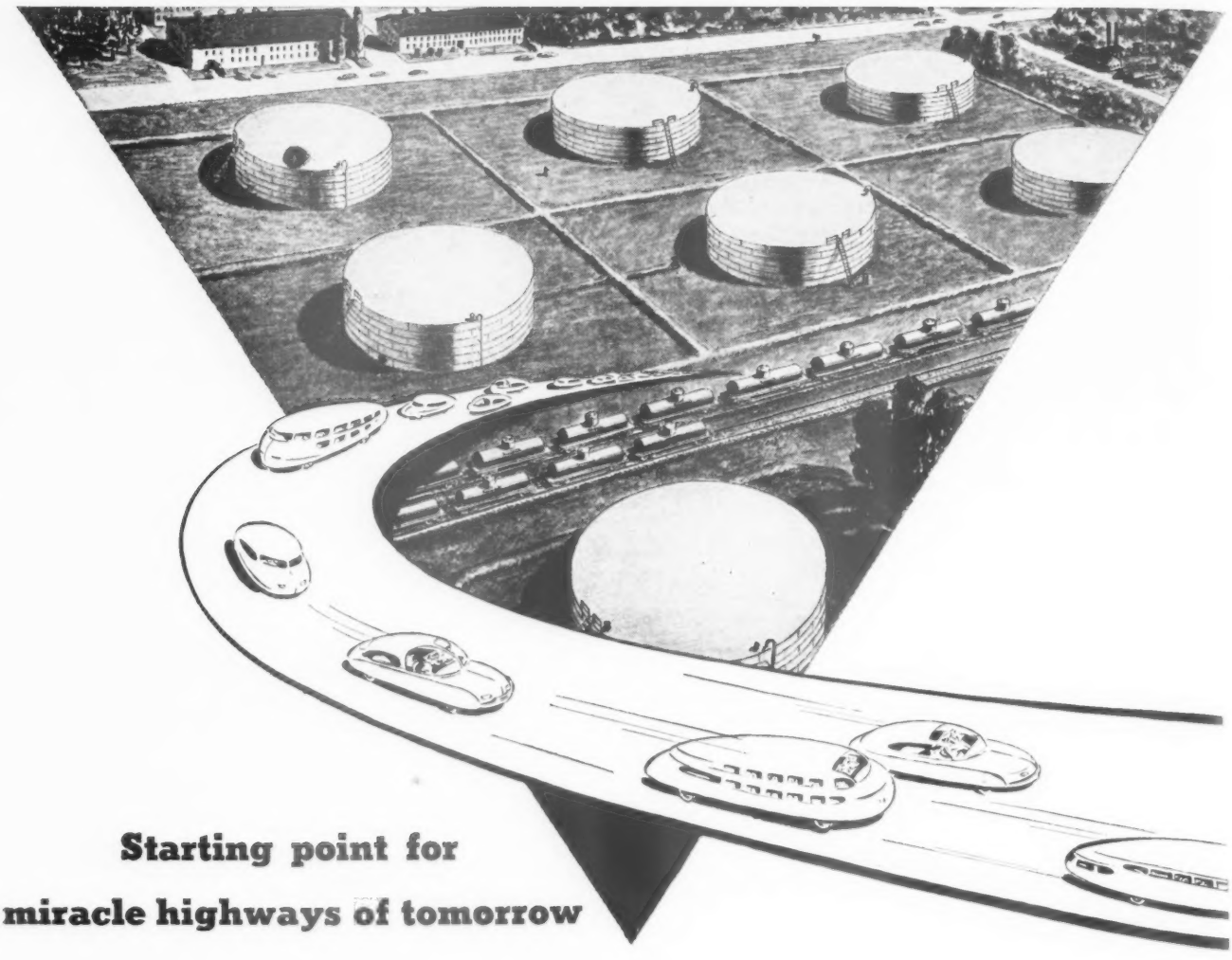

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Daily Stint of U. S. Oil Trucks Is Equivalent To 1970 Global Trips; Upkeep Crisis Near

NPN News Bureau

WASHINGTON—The amazing wartime accomplishments of American petroleum transports are only now coming to light and one revelation, based on a recent survey by ODT's tank truck section, is that these vital oil carriers travel enough miles each day to circle the earth 1970 times.

The survey, which got under way in November, was made to determine the amount of traffic being hauled by over-the-road tank trucks and the essentiality of these movements. Another reason was to gather current information upon which could be based estimates for new trucks and trailers, either as replacements or additional equipment, and for parts, tires and motor fuel.

Although the survey is not yet completed, some preliminary figures have been compiled which show the performance record of the 15,953 tank trucks in the U.S. with capacities of more than 2000 gal.

The traffic movement has been broken down by type of service: (1) direct military, (2) to other governmental agencies and defense industries, and (3) essential civilian use. Included in the last is all traffic moving for agricultural purposes.

The information has also been broken down by PAW districts, showing the relative amount of traffic moving in the various mileage brackets. Officials emphasize that these figures are preliminary but they believe there will not be a great deal of variation in the final analysis. The accompanying table shows petroleum traffic by tank trucks of over 2000-gal. capacity, both for-hire and private carriers. Figures are in gallons per day.

Other Impressive Facts

From this information, the first of its kind ever gathered on petroleum transport, many other impressive facts can be shown. Here are just a few:

1. Based on a total of 70,369,582 gal. moved daily, each U.S. tank truck of over 2000 gal. capacity hauls an average of 4400 gallons per day, or 105 b/d. The nation-wide daily average figure for tank cars, however, is only about 11 b/d, thus making each tank truck worth about 9.5 tank cars.

However, it should be pointed out, in fairness to the carrying capacity of the nation's tank cars, that many of them move in long hauls. A sizable proportion are still being used in the cross-country haul from Texas to Eastern points.

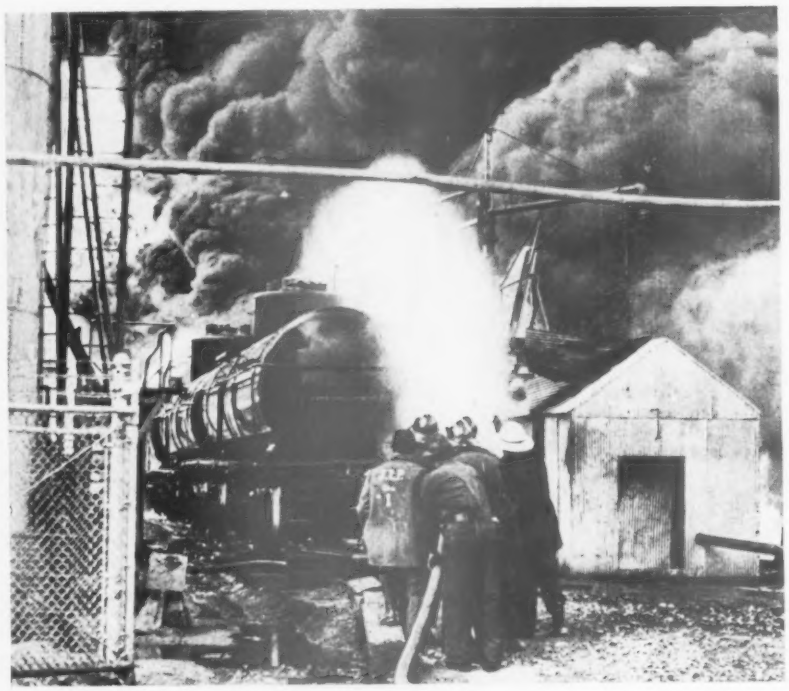
But, even so, further analysis proves that the tank truck is a mighty competitor of the tank car. For instance, on hauls of 100 miles, it is estimated that a tank car man make 3.5 round trips per month resulting in a carrying capacity of 24 b/d—still far below that of a tank truck. On hauls of 200 miles, tank cars make about 2.5 round trips per month. In this service, tank cars show a carrying capacity of 17.5 b/d.

2. Using 3000 gal. as the average load per transport, the transports in the 0-99 mile bracket carry 14,417 loads daily, and using an arbitrary figure of 130 miles as the daily round-trip of each of these

Petroleum Traffic Movement in Tank Trucks Over 2000 Gal. Capacity
(For-Hire and Private Carriers)
No. of Gal. Per Day

Distance One-Way	Total Movement Gallons	Direct To Military	U. S. Gov't Other Than Military and Defense Industries	Essential Civilian and Agriculture
P.A.W. DISTRICT 1				
0- 99 Miles	18,230,000	3,980,000	2,450,000	11,800,000
100-149 Miles	7,260,000	2,120,000	930,000	4,210,000
150-200 Miles	3,560,000	1,817,000	207,000	1,536,000
Over 200 Miles	2,740,000	1,599,000	335,500	805,500
Total Dist. 1	31,790,000	9,516,000	3,922,500	18,351,500
P.A.W. DISTRICT 2				
0- 99 Miles	15,526,000	796,000	5,990,000	8,740,000
100-149 Miles	3,644,300	238,300	796,000	2,610,000
150-200 Miles	1,565,200	149,200	366,000	1,050,000
Over 200 Miles	749,300	54,800	114,500	580,000
Total Dist. 2	21,484,800	1,238,300	7,266,500	12,980,000
P.A.W. DISTRICT 3				
0- 99 Miles	4,515,000	416,000	1,087,000	3,012,000
100-149 Miles	2,444,800	192,300	495,500	1,757,000
150-200 Miles	149,340		15,640	133,700
Over 200 Miles	503,100	35,900	114,200	353,000
Total Dist. 3	7,612,240	644,200	1,712,340	5,255,700
P.A.W. DISTRICT 4				
0- 99 Miles	1,185,400	81,300	61,100	1,043,000
100-149 Miles	282,392	3,392	106,000	173,000
150-200 Miles	197,950		32,250	165,700
Over 200 Miles	1,037,500	112,500	229,000	696,000
Total Dist. 4	2,703,242	197,192	428,350	2,077,700
P.A.W. DISTRICT 5				
0- 99 Miles	3,804,800	238,800	1,342,000	2,224,000
100-149 Miles	752,460	169,600	163,800	419,000
150-200 Miles	267,700	54,100	73,200	140,400
Over 200 Miles	1,954,400	1,093,000	85,400	776,000
Total Dist. 5	6,779,300	1,555,500	1,664,400	3,559,400
TOTAL UNITED STATES				
0- 99 Miles	43,261,200	5,512,100	10,930,100	26,819,000
100-149 Miles	14,383,892	2,723,592	2,491,300	9,169,000
150-200 Miles	5,740,190	2,020,300	694,090	3,025,800
Over 200 Miles	6,984,300	2,895,200	878,600	3,210,500
Total U. S.	70,369,582	13,151,192	14,994,090	42,224,300

DETROIT PUBLIC LIBRARY



BATTLE FUEL OIL FIRE. Firemen play a stream of water on tank cars of oil to keep them from exploding from the intense heat from fire and an explosion (background) of fuel oil at a Standard Oil Co. terminal in Richmond, Va., Dec. 23. The oil was being transferred to tank trucks when explosion occurred

carriers, they travel 1,875,000 miles daily.

In the other mileage brackets, here is about how it stacks up: transports in the 100-149 mileage bracket carry 4795 loads daily for a total of 1,197,000 miles; those in the 150-199 mileage bracket carry 1914 loads for a total of 680,000 miles per day; and transports in the last bracket, that is, over 200 miles, carry 2328 loads daily for a total of 1,165,000 miles per day. Total mileage of all of the transports, therefore, amounts to 4,197,000 miles a day.

Thus, at the present rate, the 15,953 transports in the U.S. average 308 miles per day each, or 112,500 miles per year. This average is borne out by at least one large eastern petroleum transport carrier who went into World War II with an almost brand-new fleet of about 125 units. Each of these units now has traveled an average of 220,000 miles. Many, however, have gone a great deal further; some have traveled as far as 750,000 miles.

Equipment Counted

According to a recent survey made by the tank truck section from certificates of war necessity, transport equipment of over 2000 gal. capacity in the U.S. is as follows:

PAW Districts	No. of Carriers	Trucks	Tractors	Trailers	Semi-trailers
1	1,462	2,895	3,067	692	2,468
2	1,960	819	4,422	731	3,926
3	701	522	1,570	125	1,516
4	279	188	571	124	495
5	596	1,114	777	910	742
Total U. S.	4,998	5,538	10,407	2,582	9,147

There is no segregation in the table below as to types of trucks, that is, from the standpoint of commodities carried. Tank trucks, with the exception of those which require insulation or heater coils for certain commodities and those designed for carrying high pressure liquids and foods, can be used for the transportation of practically any commodity. A relatively small percentage of the total equipment listed is designed for carrying high pressure liquids and other special commodities—an estimate would not exceed 10% of the total.

Districts on Par

WPB, at present, has authorized a total of 800 semi-trailer tanks of capacities over 4000 gal. for 1944; the power units or tractor equipment is included in ODT's truck construction program, and out of the total program scheduled next year no specific number of vehicles has been earmarked for petroleum transportation, officials emphasize. Petroleum transportation equipment at present appears to be about evenly distributed throughout the five PAW districts, officials say, and, as of today, shortages appear to be about the same in each district. All of the 5 districts are more or less on a par to the need for replacement equipment and any additional equipment will be about on the same basis.

Tank truck operations, it is pointed out, are principally intra-district in nature, with very little moving between PAW districts. Tank truck requirements for 1944, for over-the-road service, are estimated by ODT as follows (figures include both replacement units and additional units):

PAW Districts	Trucks	Trailers
1	1,490	232
2	1,310	368
3	522	122
4	189	32
5	473	46
Total U. S.	3,984	800

With the freeze on manufacture of tank trailers and trucks entering its third year, no approach to normal replacement schedules has been possible or maintained. ODT's tank truck section estimates that 25% replacement will be necessary during the coming year to maintain fleets now operating. But, one important feature of the last table above, is that there is no assurance that trucks needed as additional or replacement units will actually be allocated to petroleum carriers.

All of these statistics add up to one thing: the nation's petroleum transports, already in serious straits as regards parts and heavy-duty tires, will face a desperate situation a year hence unless, in the meantime, some sort of essentiality or priority system is set up. Another reason for a priority system is that the number of critical parts and heavy-duty tires produced in 1944 will not nearly approach the demands of all motor carriers.

Receiving Deep Study

It is understood that this question is now receiving deep study by officials so that essential motor carriers will be guaranteed the number of additional and replacement units, and heavy duty tires, they will need to carry on their operations through 1944. That petroleum carriers may head such a priority list is a distinct possibility for no other type is so closely tied to the war effort.

Adding emphasis to the present serious situation as regards tank trucks was the report a week ago by ODT that already 20% of these carriers are laid up because of the parts and tire shortages. Some in the industry fear this figure may rise as high as 30%. Some reports to ODT of idle equipment, in fact, run as high as 50%

All carriers are reporting that they are far behind in their orders. One Mid-Western carrier has reported that he has been so swamped with orders that he has been driven "nearly cuckoo." He is so short of equipment, he says, that he has turned down more hauls, or transferred them to other carriers, than he is able to handle himself.

Another report of idle equipment

"The pilots were quiet and solemn that night"...

Many tales have been told of men and tanks and planes. There is a story, too, of the drums of oil and gasoline that have gone with them to distant lands, and have played a part in strange adventures.

That story is told in "We Were There" — a modern odyssey that carries the reader through history-making exploits in Africa, the Pacific, Tunis, the Aleutians, Java and Alaska. It is profusely illustrated with original portraits of Winston Churchill, General Chiang Kai-shek, General Carl Spaatz, General Sir B. L. Montgomery, Lt. Col. Jimmy Devereux, and pencil studies of natives of Tunisia, the Aleutians and Java. A copy of the De Luxe Edition, beautifully bound, will be sent free upon request. Just mail the coupon.

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comes from a Chicago petroleum transporter who says that out of his 42-unit fleet, only 16 singles and 8 doubles are now operating; his remaining 10 singles and 5 doubles are either being repaired or awaiting repairs. He has urgently requested new tractors from ODT and they may be allocated. But, it is emphasized, such a nation-wide condition can't long endure.

From all that can be learned, it is unfortunate that many carriers fail to realize the help which can be given by ODT's tank truck section. Direct aid on many problems can be given—parts, tires, new units—and on other questions, such as manpower.

Military Is Co-operating

Faced with the present serious situation, ODT's tank truck section has, in addition to its other efforts, attacked the problem from another angle. It has obtained the co-operation of the military in helping to provide critically short replacement parts for petroleum transporters who are hauling directly to military installations or war plants.

Conferences were held several weeks ago between tank truck section members and the Army's chief of the Highway Division of the Transportation Corps. Subsequently, the names of the Transportation Corps zone officers in areas throughout the country, who could assist in obtaining necessary parts, tires, etc., were sent out to all members of ODT's state petroleum transport advisory committees and state petroleum advisory committees on local delivery.

Officials wish to emphasize to carriers that they should contact these officers, if they are in need of a part and have been unable to obtain one through normal channels, and if they are hauling direct to military or war plant installations. A list of the names and addresses and telephone numbers of the zone officers of the Transportation Corps follows:

U. S. Army 1st Zone (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont): Zone Transportation Officer—Col. Henry D. Bagnall, 80 Boylston St., Boston 16. LIberty 2875.

U. S. Army 2d Zone (New York, New Jersey and Delaware): Zone Transportation Officer—Col. E. B. Gray, 25 Broad St., New York 4. HAnover 2-4500.

U. S. Army 3d Zone (Virginia, Maryland and Pennsylvania): Zone Transportation Officer—Col. M. A. McFadden, 307 Tower Bldg., Baltimore 2. PLaza 4960.

U. S. Army 4th Zone (North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and Tennessee): Zone Transportation Officer—Lt. Col. Galvin L. Whittie, 619 Peachtree St., Atlanta 3. ATwood 5781.

U. S. Army 5th Zone (Ohio, Indiana, Kentucky, West Virginia): Zone Transportation Officer—Col. H. A. Boone, 52 South Starling St., Columbus 8, Ohio. MAin 6631.

U. S. Army 6th Zone (Wisconsin, Illinois, and Michigan): Zone Transportation Officer—Col. Dan A. Hardt, Room 542, 201 North Wells St., Chicago 6. STate 3955.

U. S. Army 7th Zone (Iowa, Minnesota, Missouri, Kansas, Nebraska, South Dakota, North Dakota, Wyoming, and Colorado): Zone Transportation Officer—Col. Harry G. Williams, 801 World Herald Bldg., Omaha 2. JAckson 7643.

U. S. Army 8th Zone (Arkansas, Louisiana, Oklahoma, Texas, and New Mexico): Zone Transportation Officer—Lt. Col. Raymond C. Stone, P.O. Box 2818, Dallas 1, Tex. RIverside 3271.

U. S. Army 9th Zone (Montana, Idaho, Utah, Nevada, Arizona, Oregon, and California): Zone Transportation Officer—Col. J. C. P. Hanley, 10 Exchange Place, Salt Lake City 1. Salt Lake City 5-7414.

When inflating tires, keep your head and face where the fender will protect you in case of a blow-out

With thousands of untrained employes replacing regular workers called into the services, the oil industry again is faced with the task of instructing personnel in the fundamentals of accident prevention. At the request of NATIONAL PETROLEUM NEWS, the National Safety Council has prepared a series of sketches which should prove helpful to the industry in instructing new employes and in serving as reminders to older employes to whom safety lectures are perhaps an old story and yet one that cannot be too often repeated. First of the safety sketches appears above

Allocation of Equipment During 1943

PAW Districts	TRUCKS Additional	TRUCKS Replacements	TRUCKS Total	TRAILERS Additional	TRAILERS Replacements	TRAILERS Total
1	431	196	627	431	27	458
2	688	373	1,061	688	44	732
3	226	337	563	226	15	241
4	61	79	140	61	4	65
5	86	28	114	86	5	91
Total U. S.	1,492	1,013	2,505	1,492	95	1,587

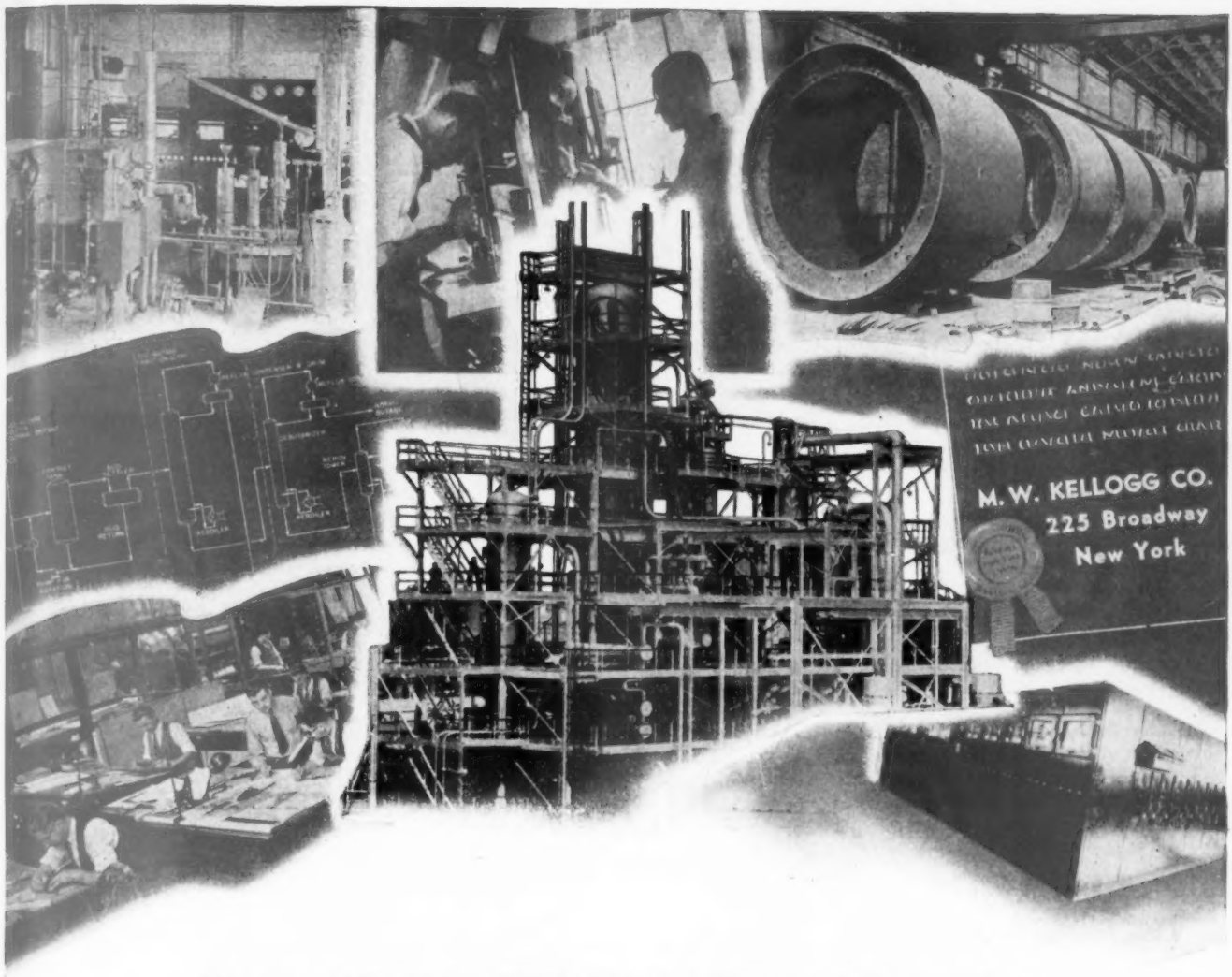
ODT Denies Certificates of War Necessity Expire

NPN News Bureau

WASHINGTON — The belief held by some holders of Certificates of War Necessity, required for all commercial motor vehicles, that such certificates would expire Dec. 31 was denied Dec. 30 by ODT. These certificates, ODT emphasized, do not bear any expiration date but remain in effect until amended, suspended, cancelled or revoked. Where certificates have been amended, new certificates have been issued. In cases where gasoline and mileage allotments were adjusted in 1943, the change will be carried over into 1944.

Rail Hauls Drop 78,703 B/D

WASHINGTON—Tank car hauls of crude and products to the East Coast for the week ended Dec. 25 averaged 570,815 b/d, a drop of 78,703 b/d under the preceding week, the Bureau of Mines reported Dec. 29. A total of 56 participating oil companies loaded 18,533 cars.



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District 2's Idle Refiners Hunt for Formula To Break Legal Dikes, Free Texas Crude

NPN Staff Special

WASHINGTON—Rapidly shaping up as oil's most critical 1944 problem is that of moving sufficient crude into District 2 to permit full utilization of 200,000 b/d of refining capacity now idle.

In view of the high District 2 gasoline yields, averaging roughly 50% from each barrel of crude, success or failure of PAW and industry efforts in this direction could well settle the question of whether civilian motorists can count on getting as much motor fuel through the new year as they did in the last, or can look for a further cut in allocations.

As matters now stand, the real drive to break through the dikes holding back the flow of desperately needed southwestern crude will get under way here next week, in advance of the Jan. 12 meeting of PIWC.

Principal task confronting District 2 refiners when they descend on the capital at that time for a final showdown will be straightening out a kink in administration thinking which led to the recent refusal of Defense Supplies Corp. to compensate those in the excess profits tax bracket for the extra costs of hauling West Texas sour crude by rail.

50,000 b/d Held Back

Not only has that ban resulted in holding back a 50,000 b/d rail movement of sour oil, but it also has placed DSC in the anomalous position of standing in the way of one of the principal crude supply measures advanced by Economic Stabilizer Vinson as an alternative to the general crude oil price increase advocated by PAW Ickes. In his Oct. 29 turndown of the price increase proposal, Vinson argued that none was necessary to secure 300,000 b/d additional production in Texas, holding that the "only bottlenecks" to its utilization were in "transportation and refinery facilities for sour crudes" and that "these bottlenecks must be broken."

The PAW request to DSC to absorb the extra rail costs of the District 2 haul accordingly represented one phase of that agency's attempt to comply with the Vinson mandate and break the sour crude bottleneck. The only catch, it now appears, is that War Mobilizer Byrnes failed to consult with Judge Vinson before instructing Jesse Jones that he must not compensate refiners in the excess profits bracket.

From all that NPN can ascertain, it seems extremely unlikely that District 2 refiners, when they arrive here, will be able to persuade DSC to change its ruling. That will mean that they will have to appeal directly to Byrnes, or possibly to Vinson, for relief, as they have promised to do (*see NPN Dec. 29, p. 3*).

PAW, meantime, is already giving active consideration to the other two points in the three-point program outlined by the refiners as a means of relieving the crude shortage. One involves moving 10,000,000 bbls. of crude now in storage in District 3 through the Little Big Inch pipeline to Norris City, Ill., for use in District 2; the other proposes relaxing the 40-acre well spacing restrictions of PAO 11.

On the first, while PAW has determined that it will be possible to run the 20-inch products line on crude with only a few minor adjustments in the centrifugal pumps, the principal difficulty appears to diverting to tank cars the heating oil scheduled to start flowing through the line to District 1 within the next few days.

According to PAW, the tank car situation is again becoming extremely tight, if not actually critical.

Only ways in which this situation could be helped, in addition to resumption of faster handling, would be by increasing tanker hauls from District 3 and the Caribbean to District 1, or by diverting all shipments of light products by rail to District 1 to pipe line and water routes.

REFINING PATENTS

Treatment of natural gasoline. Harrison L. Hays, Bartlesville, Okla., assignor to Phillips Petroleum Co. Filed June 9, 1941. No. 2,337,601.

Hydrocarbon conversion. Charles L. Thomas, Chicago, Ill., assignor to Universal Oil Products Co. Filed Feb. 28, 1941. No. 2,337,630.

Production of high octane blending stocks. James Burgin, Oakland, Calif., assignor to Shell Development Co. Filed Sept. 15, 1941. No. 2,337,640.

Solvent refining. Oscar Larson, Associated, Calif., assignor to Tide Water Associated Oil Co. Filed Feb. 5, 1940. No. 2,337,689.

Recovering finely divided solids from gases. Fred W. Scheineman, Chicago, Ill., assignor to Standard Oil Co. (Ind.) Filed April 24, 1941. No. 2,337,684.

Beneficiating light hydrocarbon distillates. Robert E. Burk and Everett C. Hughes, Cleveland Heights, Ohio, assignors to Standard Oil Co. (Ohio). Filed July 9, 1940. No. 2,337,732.

Acid treatment of oils. Milton W. Lee, Palos Verdes Estates, Calif., assignor to Union Oil Co. (Calif.) Filed Dec. 2, 1940. No. 2,337,826.

Catalytic reactions with carbonaceous materials. Fritz Stonewener, Germany; vested in Alien Property Custodian. Filed April 17, 1941. No. 2,337,944.

Conversion of hydrocarbon oils. Joseph M. Barron, Port Arthur, Tex., assignor to Texas Co. Filed Feb. 25, 1941. No. 2,338,020.

Converting hydrocarbon oils. Thomas P. Simpson, John W. Payne, and John A. Crowley, Jr., Woodbury, and Clark S. Teitsworth, Plainfield, N. J., assignors to Socony-Vacuum Oil Co. Filed April 13, 1940. No. 2,338,063.

MISCELLANEOUS

Method of producing catalytic material. Walter A. Schulze and John C. Hillyer, Bartlesville, Okla., assignors to Phillips Petroleum Co. Filed Feb. 21, 1941. No. 2,337,628.

Plasticizer. Hooper Linford and Arthur L. Blount, Palos Verdes Estates, Calif., assignors to Union Oil Co. (Calif.) Filed July 1, 1940. No. 2,337,671.

Compiled by R. E. Burnham, patent and trade-mark attorney, 511 11th Street, NW, Washington 4, D. C., from whom copies may be obtained at rate of 25c each. State number of patent and name of inventor when ordering.

Both measures would have the effect of releasing tank cars for service to District 2, but that raises again the question of whether the industry would make use of them if Jones' "no compensation" edict is allowed to stand.

As to a possible relaxing of well-spacing regulations, the attitude here seems to be that drilling on closer patterns would only partially and temporarily stem the decline in productive capacity in District 2. PAW nevertheless is looking closely into this phase of the problem and has told the War Production Board unofficially that if more steel should become available in 1944 it wants first call.

PAW Studies Proposal

Studies looking to relaxation of spacing regulations not only are under way now in western Kansas, Oklahoma and other parts of District 2, but also in the various other PAW Districts. A fear in the minds of PAW production experts, however, is that a decision to permit 10-acre spacing throughout District 2, as proposed by the refiners, might actually result in getting less oil than is being produced now for the reason that many producers would have to use steel to drill 10-acre offsets.

DSC Sets Jan. 31 Deadline On Compensatory Claims

NPN News Bureau

WASHINGTON — Applicants for petroleum compensatory adjustments under DSC Regulation 1 were notified last week by DSC General Counsel George H. Hill that supplementary claims under Amendment 2, for which no previous claim has been filed and which were commenced Dec. 31, 1942, and prior to Sept. 16, 1943, will be accepted by DSC if filed on or before Jan. 31, 1944, provided, however, that applications for approval of such movements were received by PAW on or before Dec. 31.

DSC will waive the requirement contained in the last paragraph of Amendment 2, to the effect that such supplementary claims were required to be filed on or before Dec. 15.

Synthetics To Give Crude Rubber Stiff Postwar Competition—Dewey

Rubber Director Cites Facts, Figures Based on Wartime Data Showing Buna Will be in Excellent Competitive Position

NPN News Bureau

NEW YORK — Crude rubber at 16c a pound will get plenty of competition from post-war synthetic rubber in the U. S., according to Rubber Director Dewey who cited facts and figures on wartime production before rubber industry leaders last month in New York.

Mr. Dewey made the forecast in accepting the Sixth Biennial Award for Chemical Engineering Achievement on behalf of the American Synthetic Rubber Industry.

"Buna S, even at this early date, is probably of a quality good enough so that, under postwar conditions, it could without any large price advantage, replace up to one-half of the crude rubber previously used," Mr. Dewey said.

Text of Mr. Dewey's address follows.

By Col. Bradley Dewey

NEEDS OF THE WAR were the only reasons for building the huge Government plants to make synthetic rubbers and their raw materials. These plants have already produced over 140,000 long tons of synthetics. This month they will produce about 45,000 long tons, next year over 800,000 long tons, with a capacity by the end of the year of 850,000. These productions are not excessive. They are being used as fast as made. It has been a close call and without the stockpile of natural rubber which was built up under Mr. Jesse Jones' guidance from 125,000 long tons at the end of 1939 to 634,000 long tons at the peak on April 30, 1942, this country would already have faced disaster. We can thank heaven that the Japs did not strike in 1939!

What is to become of the synthetic plants after the war? We must never again run the risk of being caught without either a good-sized synthetic rubber industry or a stockpile large enough to carry us through until standby plants can be brought into production or a pilot-sized industry adequately expanded. I, for one, hold no brief that synthetic rubber should continue after the war as a pampered, subsidized or protected industry. But, of course, we must never again get caught without rubber and the actual situation as to postwar supply and price levels of natural rubber, rather than economic philosophy, will ultimately determine the future. With these thoughts in mind let us objectively examine some of the probabilities, remembering that nothing I present here is to be interpreted as reflecting a set Government policy.

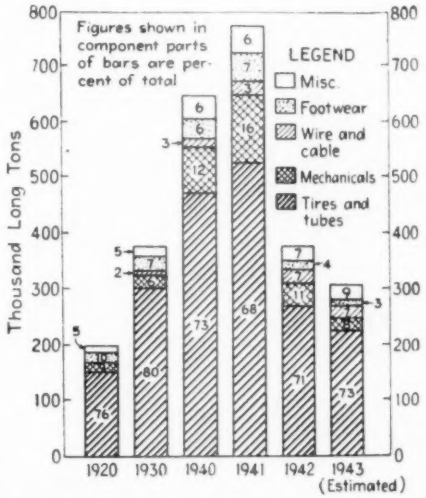
Plants Well Constructed

The very nature of the products made or used, and the fire and explosion hazards incident to handling them, led the designers of these plants to build well. If properly painted and cared for as standby plants they would not suffer greatly from atmospheric corrosion. However, wear and tear under operating conditions differs not only from process to process but also in the various parts of each process. It will probably average out about the same as for chemical, paper and petroleum refinery plants.

Because of different processes and locations, there is no reason to believe that at the end of the war there will be any relationship between the initial cost of a given plant and the out of pocket cost at which it can manufacture its product. However, the fact that some of the special synthetics such as Neoprene, Buna N and Butyl have qualities not found in crude rubber, will assure them of some place in the postwar picture. Neoprene and Buna N are quite different from each other, but each is relatively unaffected by oils which destroy ordinary rubber compounds. Butyl has very high tear resistance, remains remarkably flexible at very low temperatures, and is most resistant to the passage of air. Some synthetics may find a place in combination with plastics. The qualities inherent in each assure us that these synthetics will survive and that we can let the future determine the extent to which their production will shrink or grow from that of the present program. The gradual determination of what the public will pay for their special qualities will determine the magnitude of the ultimate post-war market for each.

Have Standby Value

But in the case of Buna S, which represents 86 per cent of the present program, the very diversification entailed in spreading of the initial risk by selecting and developing a number of processes means that the units with high processing costs cannot hope to compete after the war. Once conditions return to anything like normal and crude rubber is again importable, the high cost units will have their value only as standby plants or ultimately for what can be realized for their equipment in the second-hand or scrap markets. In short, they will be in the same boat with a laid-up battleship that might ultimately go to the scrap heap because of obsolescence or a disarmament agreement. Just as will be the case with shells, guns, tanks and battleships, they will have done their part in the war effort and the loss they represent will be but part of the tremendous waste incident to any and every war.



U. S. consumption of crude rubber and latex by major product classification, 1920, 1930 and 1940-43

The question of what should be done with the low-cost producers will be an entirely different one. What will be their competition? In the past, as a result of various plans and schemes for reducing output, plantation rubber has had a checkered price career which has brought with it uncertainties as to investment in new uses of rubber as well as hazards as to its backers. Under the latest scheme for restriction of exports from the Far East, starting in 1935 the minimum price f.o.b. New York for No. 1 ribbed, smoked sheets was 10½c per lb.; the maximum was 13¾c and the ranges for each of the succeeding years were from approximately 13½c to 23¼c; 14c to 27c; 10¼c to 17¼c; 15¼c to 25c; 18¼c to 25c; and 19¼c to 25c. The costs of rubber from various plantations varied by about 100 per cent dependent upon location, amortization policies, yields of particular plantations and the efficiency of managements.

The past background of some of the older plantations which were built in the days of very low labor charges and had long since fully amortized their development costs was such that they were able to pay dividends with rubber selling below the cost of younger and even higher yielding plantations. The same was true of rubber from native plantings where the natives lived off the land and looked to the yield of a few trees for their "cash crop."

A "Heaven-Sent Brake"

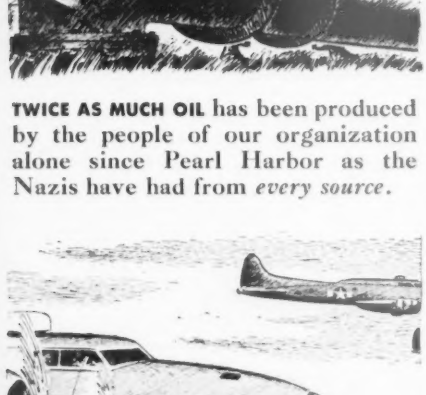
Though the situation at the end of the war will be confused by the variable states of repair and regrowth to jungle that may or may not characterize some of the plantations when the Japs are finally driven out, nevertheless it seems probable that there will be quite a supply of rubber, perhaps over 500,000 tons, which on the basis of prewar costs could be profitably imported with prices f.o.b. New York as low as 10c per pound. But once the world demand for rubber exceeds the readily available fraction of the total supply, the price will probably be limited by the costs of synthetics. In fact, in the absence of synthetic rubber, the abnormal demand that will undoubtedly exist for two or three years after the war, while worn-out vehicles and tires are being replenished, would be enough greater than the readily available crude supply to result in abnormal prices until demand slackened or venture capital went to the expense of cleaning out the jungle from overgrown plantings or of planting new areas or replanting old areas with higher yielding stocks.

Faced with such a situation it seems almost obvious that a consuming nation such as the United States, which goes to work and play on wheels and which transports its products and foodstuffs on rubber, will, of necessity, find its low-

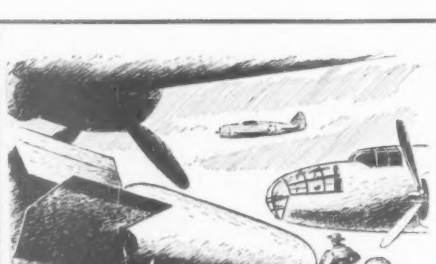
"Oil has not been lacking

Modern war has to have gigantic amounts of petroleum. More than half the tonnage of supplies for the North African invasion was petroleum. The 46,521 employees of the operating companies associated with Standard Oil Company (New Jersey) are deeply conscious of their responsibilities in meeting the war's needs. Here is a partial list of their accomplishments to date . . .

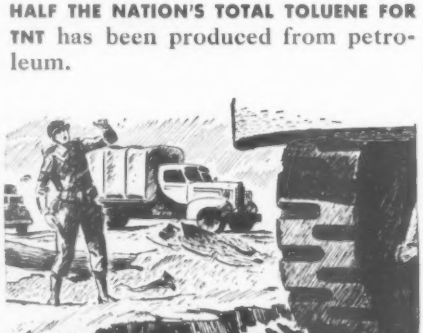
TWICE AS MUCH OIL has been produced by the people of our organization alone since Pearl Harbor as the Nazis have had from *every source*.



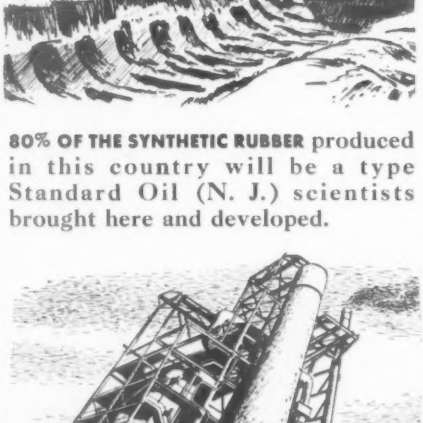
100-OCTANE SUPERFUEL from our organization's refineries has powered one in every four warplanes of the U. S. and Great Britain.



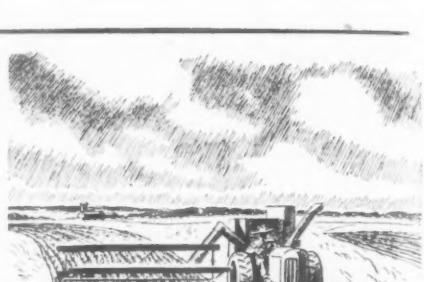
HALF THE NATION'S TOTAL TOLUENE FOR TNT has been produced from petroleum.



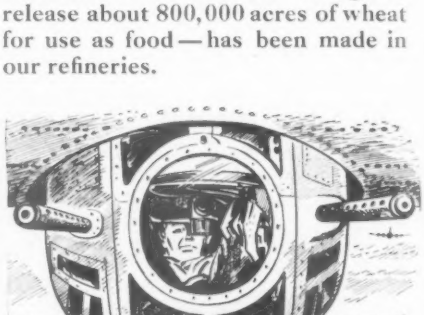
80% OF THE SYNTHETIC RUBBER produced in this country will be a type Standard Oil (N. J.) scientists brought here and developed.



THE "JERSEY FLUID CATALYTIC" CRACKING PROCESS, developed in our laboratories, has been selected for over 50% of all catalytic cracking plants now in operation or under construction.



ALCOHOL FROM PETROLEUM—enough to release about 800,000 acres of wheat for use as food—has been made in our refineries.



THE OILS ESSENTIAL FOR AIRCRAFT HYDRAULIC CONTROLS in stratosphere cold were originated by our research chemists.

THE RUST PREVENTIVE which protects delicate internal parts of airplane engines during shipment was originated in their laboratories. For a long period we alone supplied this to every American airplane engine maker.

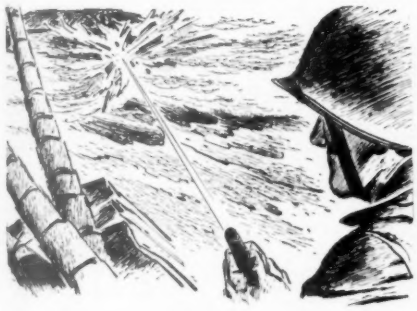
(THIS MESSAGE HAS BEEN REVIEWED IN FULL BY THE ARMY AND NAVY, WHICH HAVE NO OBJECTION TO ITS PUBLICATION)

on any Battle Front..."

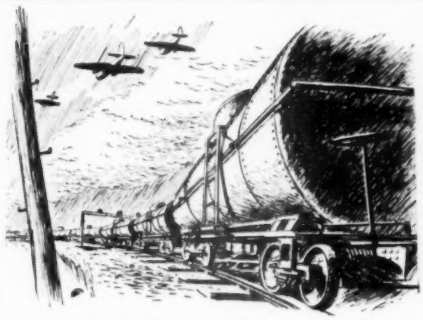
(RALPH K. DAVIES,
DEPUTY PETROLEUM ADMINISTRATOR FOR WAR)

VISTANEX, A RUBBER-LIKE MATERIAL, which was the first satisfactory *insulation* for certain vital electrical military equipment, was perfected by our people.

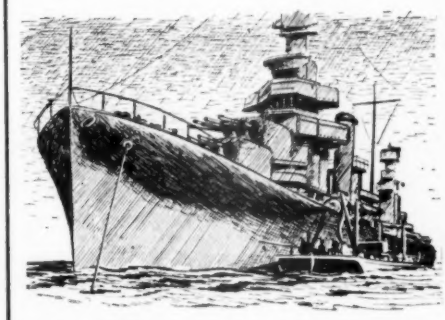
A NEW "LARGE AREA" SMOKE-SCREEN GENERATOR, developed from an idea given us by General Electric, protects our troops and equipment in territory captured from the enemy.



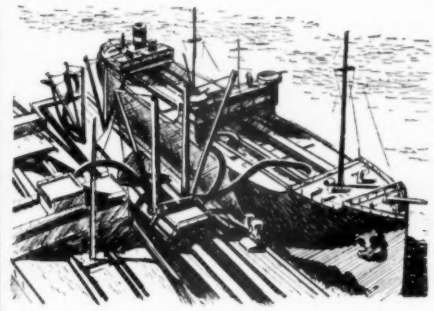
A REVOLUTIONARY FLAME THROWER AND NEW INCENDIARY BOMBS helped earn the Army and Navy "E" Award for our research laboratories where they were developed.



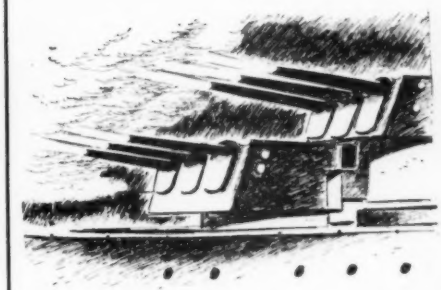
ARMY-NAVY REQUIREMENTS from them jumped almost 700% from 1941 to 1943—and we take pride in the many commendations we have had for meeting demands on time.



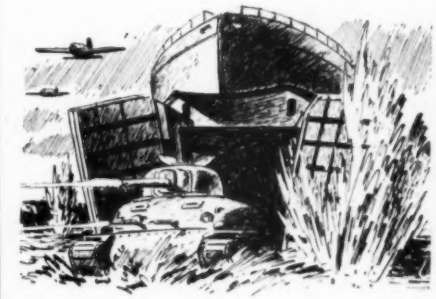
OVER HALF OF ALL U. S. NAVY AND MERCHANT SHIPPING in the Atlantic has been supplied with fuel oil from their refineries, tankers, and loading terminals.



ONE-FIFTH OF ALL TANKER TONNAGE, privately owned under the U. S. Flag, is now operated by this organization. At some 200 ports the world around, we offer fueling facilities to ships of the United Nations.



GUNFIRE CONTROL MECHANISMS like those on the famed U. S. S. Boise are made at one of our plants which formerly made oil burners and gasoline pumps.



OUR "KNOW-HOW", AS WELL AS OUR PRODUCTS, has helped many times. For one example, the Army requested that one of our men set up and direct the loading into blitz cans and drums of all gasoline for the North African invasion—18,000,000 gallons in 21 days.

We take keen pride in the wartime record of the people of the operating companies associated with Standard Oil Company (New Jersey). There has not been a single strike since long before Pearl Harbor. Their absentee record is among the lowest. 5,892 of them have gone into the fighting forces. 46,521 remain to back them up.

DEWEY ON POSTWAR RUBBER

(*Continued from p. 25*)

cost synthetic rubber a heaven-sent brake on the cost of its tires and other rubber products. If we consider that the most rubber ever actually used by this country in any one year prior to 1941 was 650,000 tons out of world shipments of approximately 1,390,000 tons and that at least half of the present 850,000 tons synthetic rubber program should be relatively low-cost Buna S, it is evident that there is a second question which is of greater interest to you chemists, chemical engineers, and executives who have played such a vital part and done such a magnificent job in building up the synthetic rubber program. It is this: We know that we have already made some low-cost Buna S at out of pocket costs, including reasonable management fees but before depreciation of less than 14c per pound. But are we going to hold our plants only as standbys to prevent others from charging us over 15c per lb. or is it possible that some low-cost synthetic rubber can and will be made at prices which will compete with the lowest average price at which the crude rubber producers will be willing to sell their production? Obviously such a price would have to be less than that price which would make it attractive for venture capital to develop new plantations or replant old plantations under postwar conditions. This will in turn be affected by the extent to which the war has changed the economic perspective of the natives. Will a change in their standard of living change tapping as well as planting costs? The days of imported indenture labor may be over. What taxes are the local governments going to levy to support their concepts of a new order? It has been proven that much higher yields are attainable,—but what will be the costs?

The Question of Price

This brings us to the question of the price at which we can expect to see Buna S or its postwar sons and daughters (whether copolymers or tripolymers) manufactured after the war. In this discussion I assume no inflationary changes in values. There is every reason to expect that costs for labor, chemicals, maintenance, supervision, utilities, including a management fee of approximately ½c per lb., and ¼c for research, but excluding depreciation, when running at capacity will be in the neighborhood of 4½c per lb., and that with butadiene at 8c per lb. and styrene at 8c per lb. f.o.b. a copolymer plant, the resultant cost of the Buna S, excluding depreciation, will be approximately 12c per lb. When running at reduced capacity, this cost might be up to 1c per lb. more. However, of this 12c approximately 6c will represent the cost of butadiene and the question of whether or not butadiene can be made at 5c, 6c, 7c, or 8c per lb. will depend in a large measure upon factors which cannot be too accurately appraised at the present time.

When butadiene is made from alcohol the costs per lb., exclusive of depreciation, will not be higher than the cost of the alcohol used plus 2c for processing charges. If, and notice that I say "if", alcohol is available at 12c per gal., the resultant butadiene should cost, before depreciation, not over 7½c per lb., less any by-product credits that might be realized from now discarded waste oils and gases. With alcohol at 15c the corresponding cost is 8.6c. In the case of butadiene from petroleum products the ultimate cost of the butadiene will depend in large measure upon whether the butylenes inevitably produced by the operation of catalytic crackers are worth more for any other use than their value as a constituent of motor gasoline. If crude oils are available at approximately today's prices and motor gasolines continue to sell at the refinery for approximately 5c per gal., butylenes should be available for the operation of some of the butadiene plants at 5c per gal. Such a price would justify the hope of making butadiene, *before depreciation*, at 7c per lb. There are some who envision as low as 6c per lb.; 8c should be readily attainable.

In the case of styrene it so happens that prospects are for almost identical costs, so that when all is said and done it seems probable that Buna S can be made postwar, before depreciation, for about 12c per lb.

The Depreciation Problem

As to the question of depreciation, it is of interest to note that for what now appear to represent the low-cost larger plants of the program the costs per ton per year of plants necessary to build the raw materials for Buna S and to copolymerize them will, after giving due weight to probable actual outputs, be approximately, — styrene $79, butadiene $336, copolymer $151, so that if it is assumed that the postwar costs of these under normal building conditions would be 60% of these costs, and it is assumed, after due consideration of the large proportion of the costs represented by permanent structures and utilities, that they should be fully depreciated in 15 years, the resultant total cost per lb. for amortization of the plants for butadiene, styrene and Buna S running at capacity will be approximately 1.05c. per lb. of Buna S. But many feel that since we have the plants paid for as a cost of war and they are of no going value unless used, why consider even this small depreciation charge?

It does not take any great seer to observe that the above minimum cost of Buna S works out to about the probable minimum price at which venture capital under prewar, but not necessarily postwar, conditions would have gone into new plantations on a large scale. But there is another factor which, in all probability, will play a great part in the postwar picture. The war has given a great impetus to the development of transportation based on the use of petroleum and rubber.

The industrial renaissance which has already come to pass in Russia and which is coming in China, India and many parts of Africa, the Far East and other parts of the world, is going to demand tremendous additional tonnages of rubber. Furthermore, in the past the use of rubber has been considered for many places where venture capital would have felt justified in developing new products if it had been assured of rubber at 15c. to 16c. per lb., but where it was not justified when it had to gamble on the price of "futures" and there was an ever present danger of a runaway price. All too often the success or failure of rubber companies of the past has depended upon wide fluctuation in the price of rubber. If the net result of the competition between synthetics and crudes is a price of 16c. or below, many of these new uses for rubber may be developed.

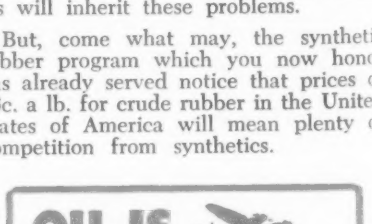
Buna S Market Assured

Buna S, even at this early date, is probably of a quality good enough so that, under postwar conditions, it could without any large price advantage replace up to one-half of the crude rubber previously used. Its quality and the techniques incident to using it are being and will be further improved so that before the abnormally large demands of the war and a few years thereafter have been filled its usefulness should closely approach, equal, or possibly surpass that of crude rubber. By then the problems incident to its loss of strength when hot, its low resistance to cut growth, and its tackiness should have been solved.

The problem of hysteresis heating may still give trouble for some uses, but there is reason to hope that it will be solved. In the light of the above, it seems that those who will have to decide as to the postwar handling of the low-cost synthetic rubber plants owned by the Government may well seek to find a way by which they can be operated to give a reasonable return to the operator and yet permit him to sell the resultant rubber at a price which will set such a ceiling on crude rubber as to preclude any ill-considered speculative plantings which in the long run would result in temporary over-production, followed by the death of synthetic rubber and more world-wide orgies of limited production and high prices for crude rubber.

If it seems best to aim at prices in the neighborhood of 15c. or 16c. per lb. there may well be some formula by which industry and the Government will realize some return in lieu of a full amortization or rental charge for all its war costs. Some will argue that the important point is to realize that the money has been spent for war purposes and that without any charge for depreciation any postwar return should be looked upon as an accidental bonanza, not as the just due of the money already spent. Others will argue that the plants should not be operated unless they bring the Government a full return on at least their replacement cost under postwar conditions. Postwar leaders will inherit these problems.

But, come what may, the synthetic rubber program which you now honor has already served notice that prices of 16c. a lb. for crude rubber in the United States of America will mean plenty of competition from synthetics.



Never more vital than now!

How Vital are Spark Plugs?

Automotive transportation is essential to war production—depends directly on them to a great extent. To "keep 'em rolling" was and is a real necessity, and a real problem.

The automotive service industry has performed miracles in this respect, particularly in the light of the manifold handicaps under which they are working.

Champion has met the requirements first, of our armed forces and those of our allies, and secondly the needs for essential transportation on the home front.

The demand for Champion Spark Plugs is steadily increasing, and every day they are adding to their reputation for better performance, on land, water and in the air, at home and on far flung battle fronts. This not only is recognition of the vital character of spark plugs—but a great tribute to the traditional dependability of Champions.

DEPENDABLE

Champion Spark Plugs

LET'S ALL BACK THE ATTACK — BUY BONDS

Texas Output Boosted Nearly Fifth in '43

Special to NPN

AUSTIN, Tex. — Texas in 1943 produced 587,758,689 barrels of oil, an increase of 109,930,469 barrels (18.7 per cent) over 1942 production, Chairman Beauford Jester of the Texas Railroad Commission has announced.

The greatest part of this increase came from West Texas, which turned out 16,685,651 barrels more in 1943 than in 1942. The chairman said that these fields were practically the only ones left in the state that could increase production without waste.

Jester's report, prepared by Jack Baumel, the Commission's director of production, showed 114 new field discoveries in 1943 against 84 in 1942. (The term, "new field", has been liberalized to encourage drilling). There were 2,263 completions in 1943, compared to 3,006 the preceding year, and 1,525 dry holes, an increase of 336 over 1942.

Jester pointed out that in the 30 new field discoveries, the fields were smaller and more expensive to develop, due to increased costs of labor, materials and overhead.

Stands Pat on Increase

"The Commission has thrown its weight behind the effort to secure a minimum 35-cent increase in the price of crude," the commissioner commented, "and will continue to do so and will continue to oppose any subsidy in lieu of a price increase."

The chairman said that during the year two developments in the Texas oil outlook had showed progress: Reinjection of salt water in the big East Texas field, and the state-wide trend toward the so-called "dual completions".

In 1942, he said, East Texas' water return program saw 29,395,506 barrels reinjected into its original horizon, and in 1943 the total was increased to 64,131,712 barrels.

Dual completions, he pointed out, increased from 66 in 1942 to 144 in 1943. In addition to the wells dually completed for both oil and gas production from different strata, 86 wells were completed as dual oil producers—producing oil from two sands, while in the Lake Creek field of Montgomery County, two wells were triple-completed.

Canol Reserves Estimated at 35,000,000 Bbls. In N. J. Standard Review of Arctic Oil Quest

NPN News Bureau

NEW YORK — The Fort Norman oilfield reserves may exceed 35,000,000 bbls., it was revealed last week by Standard Oil Co. (New Jersey). The company published a brief history of Northwest Territories oil exploration, the significance of the famed Canol project, and terms under which the U.S. Government contracted with Imperial Oil, Ltd., Standard subsidiary, for the development of the Arctic reserves. Jersey Standard's compilation is issued in a booklet entitled "Power to Strike from Alaska", in which the company explains its share in the project sponsored by high ranking Army officers as an attempt to make available petroleum products for the Alaska war theatre.

Disclosing for the first time the resources of the Fort Norman field, Standard said:

"Actual drilling has provided additional data on the probable oil reserve existing at Fort Norman. At first considered to consist of only a few million barrels, it now appears that the field may exceed 35,000,000 bbls. This size field, while large, is not exceptional when considered in terms of major U.S. oilfields. It is about the size of the average major oilfield in the U.S. Not all of this oil is accessible since much of the oil-bearing structure lies under the bed of the Mackenzie River."

Canadian drilling crew operates a derrick at Norman Wells, one of the scores of new wells sunk in this area as part of the Canol project

The account reveals that drilling operations in the Fort Norman area have been carried out continuously since July, 1942, by Imperial in spite of Arctic winter conditions.

"This is the first time such operations have been continued through the rigors of a North Canadian winter. Winter temperatures in this region reach 70 degrees F. below zero and have presented extraordinary difficulties. Sixteen wells were drilled by the end of 1942, sufficient to supply the full original production of crude desired by the U.S. Army. By Aug. 1, 1943, a total of 25 wells including two exploratory outside the Norman Wells area, had been completed, 20 of which may be classed as commercial producers. This has been achieved in what to many oil men appears an incredibly short period of time. Although production from the field has been satisfactory, not all the wells drilled have been producers."

Push Exploratory Work

Additional exploratory work is now underway, says Standard, for selection of drilling sites on prospective oil structures.

Concerning the contract terms under which the project was begun, Standard says Imperial's deal with the Army amounted to only $5,000,000 of the estimated $134,000,000 for the entire project.

"Imperial contracted to develop oil production of 3000 b/d from its long-existing leases in the neighborhood of Norman Wells, and from additional leases in that region, obtained from the Dominion of Canada, and to sell this oil to the U.S. Government at pipeline terminals near Norman Wells. Subsequently the Army increased its requirements to 20,000 b/d.

"The original requirement has been met and surveys are now under way to develop further production to provide additional oil requested by the Army.

Contract Terms Outlined

"Both the original and supplementary contracts are drawn on the U.S. Army's regular cost-plus-fixed-fee form. In each case the fixed fee is $1. The estimated cost of the work under the first contract is $2,000,000; under the supplementary contract, $3,000,000, both sums in Canadian currency.

Terms of the contract as reported by Standard include:

"(a) Imperial was directed to drill sufficient additional wells to increase if possible the production in the Fort Norman area.

"(b) Since such additional oil production had no normal commercial outlet, the U.S. War Dept., whose military operations required the additional oil,

financed the direct cost of the operation, but all funds advanced to Imperial were to be repaid to the U.S. Government under conditions explained below.

"(c) The first oil produced from the wells drilled would be sold to the U.S. Government at $1.25 (Canadian) per barrel. By way of comparison, the cost of delivering U.S. crude to the Fort Norman area by then existing transportation facilities was about $6 a barrel.

"(d) Imperial would produce oil at the maximum continuous rate consistent with good practice from its four production wells already existing, and process this oil year-round in Imperial's local refinery into desired products. The Government would buy these products at a price equivalent to $1.75 (Canadian) per barrel of crude (the $0.50 differential over the $1.25 crude being to cover Imperial's existing investments in equipment and the producing cost), plus a price of $0.65 (Canadian) per barrel refining costs for converting this crude into products if such products were desired by the Army.

"(e) After purchase by the U.S. Government of 1,500,000 barrels of crude oil, the price paid for further amounts would be reduced to $0.50 (Canadian) per barrel, this price to be maintained until the Government had been repaid all advances made under (b) above, this repayment to be calculated at the rate of $0.75 (Canadian) per barrel.

"(f) Thereafter, the U.S. Government would continue to pay $0.50 (Canadian) per barrel of crude produced, but would put aside an additional $0.75 (Canadian) per barrel in a special fund to be explained below.

"(g) When the extra facilities were no longer required by the U.S. Government, Imperial would have the right to try to negotiate for their purchase within a 6-months period at a price to be agreed upon. If this option were exercised the amount accumulated at $0.75 per barrel in the special fund mentioned under (f) above would be applied against the purchase price. Any amount in the special fund not used in exercise of this option would become payable to Imperial."

'43 Crude Production Up 8% Bureau of Mines Reports

NPN News Bureau

WASHINGTON—The Bureau of Mines reports the record production of crude petroleum in 1943 as estimated at 1,503,000,000 bbls., with a value at the well of approximately 1,818,000,000. Compared with 1942, this represents a gain of about 116,000,000 bbls., or over 8%. The increase in value was due largely to the greater volume of production as the value per bbl. is estimated to have risen less than .02c above the average of $1.19 in 1942.

A small increase in crude stocks indicates that production closely approximated demand. The total demand for motor fuel in 1943 was about the same as in 1942 with increasing military demands offset by the curtailment of civilian consumption due to rationing. Total demand for residual and distillate-fuel oils apparently showed an increase of about 14% compared with 1942. These 3 products combined account for over 81% of the refinery output.

Oklahoma Allowable Set

Special to NPN

OKLAHOMA CITY—The Oklahoma commission has set total January allowable at 354,000 b/d, unchanged from December and 2000 b/d under PAW recommendation. Of the total 29,000 b/d was allowed for petroleum liquids other than crude.

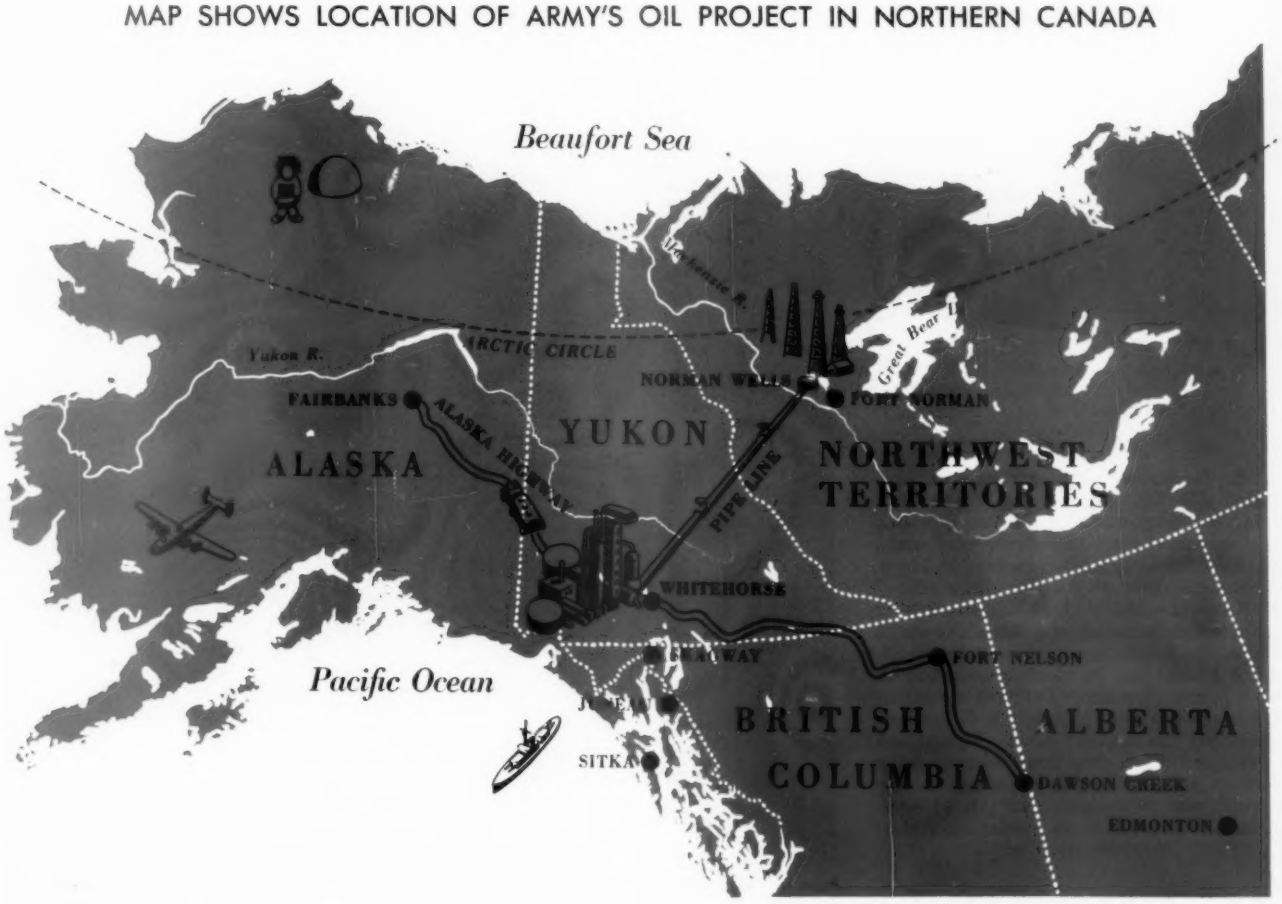
Average daily production during November was 336,701 b/d of crude and 28,700 b/d for other petroleum liquids. Three pools were added to and two were taken off proration during the month.

Another Million-and-a-Half In Wells for Bob Smith

Special to NPN

HOUSTON—R. E. (Bob) Smith, Houston independent oil operator, has purchased 36 wells in the East Texas field from Thomas B. Humphreys of Dallas. The purchase price was $1,500,000.

MAP SHOWS LOCATION OF ARMY'S OIL PROJECT IN NORTHERN CANADA



Courtesy Standard Oil Co. (N. J.)

Handling Petroleum in War No. 1 was Far Cry from Today

First World War Supply Officer's Story Contrasts Equipment Available for Supplying Military Forces in Two Wars

By W. W. Weston
NPN News Editor

"Since writing the above story, all of us have read in the papers and in the oil magazines of the portable gasoline pipeline designed by Sidney S. Smith of the Shell Oil Co., Inc., New York City, and put into service in North Africa in a July offensive—capacity 250,000 *gal. a day. What a change only* 25 *years can make."*

WHAT A CHANGE only 25 years can make!

F. R. Newman, who made that observation at the end of an article he wrote for the house organ of Allied Oil Co., Inc., Cleveland, of which he is secretary-treasurer, knows what he is talking about. He could have used one of those pipelines himself back in 1918 at Auzeville, France, a couple of kilometers behind the front line at Clermonten-Argonne. He could have used some of the big gasoline transport trucks with power take-offs and meters that the Army now has; and some of the collapsible storage tanks, some of the safe, handy "blitz" cans, some of the multiple-outlet, power-driven pumps which can refuel eight trucks or fill eight barrels or cans simultaneously. In fact, he could have used some of all of the petroleum handling equipment the oil industry and its equipment suppliers have developed since the last war, now being used in great numbers to speed mechanized equipment over worldwide battlefronts.

Faced "Gas" Shortage

First Lieut. F. R. Newman, Gasoline & Oil Branch, Quartermaster Corps, U.S.A., wouldn't have needed much of this equipment at Auzeville, comparatively speaking, even if he had handled the

F. R. Newman, secretary-treasurer of Allied Oil Co., Inc., above right, who tells his experiences in handling gasoline and motor oils for the Army in France in 1918. Directly above is part of Lieut. Newman's crew at the "gasoline office" at Auzeville, with Lieut. Newman pictured at extreme right. Also shown is one of the converted water trucks which did a heroic job in moving gasoline to the fighting divisions. Below is a modern Army tank truck refueling a Grumman "Avenger" in combat area. Equipment developed since the last war to help deliver petroleum to consumers at the lowest cost is making the job of handling military products easier on global battlefronts today

entire "sea of oil" upon which the Allies of the first world war floated to victory. But a little of it would have come in handy in the late summer of 1918 when, just after St. Mihiel, a gasoline shortage threatened U. S. troops at the front because the barrels and cans it had been handled in were not returned to supply depots fast enough.

World War II's gasoline requirements are 80 times greater than World War I's. A mechanized infantry division burns up 12,000 gal. per 100 miles; a flight of 1000 four-engine bombers on a 6-hour mission eats up 1,800,000 gal. of 100-octane gasoline. Petroleum-powered fighting equipment unknown 25 years ago—landing craft of all types, amphibious combat vehicles, tanks weighing 60 tons, half-tracs carrying attack and anti-aircraft guns—and petroleum-powered vehicles of supply for food, medical and engineering equipment, ammunition and fuel, are all drinking prodigious quantities of gasoline and using immense amounts of specialized lubricants and greases.

Equipment Keeps Pace

Having this supply of petroleum products is only half of the answer; having equipment to haul it and handle it—to get it where it's needed, when it's needed, and in sufficient quantity—is the other half. The products of the manufacturers of the oil industry's equipment, showing constant improvement since the last war because of the oil industry's competitive battle to get products to the consumer at the lowest cost, have thus kept pace with the needs of the armed forces and are now proving themselves in global war.

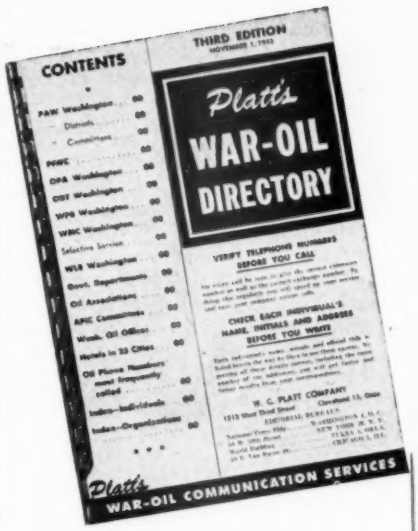
Twenty-five years ago the American Army in France showed the world's military experts that gasoline could be handled in bulk in combat areas. Lieut. Newman helped the Army prove it. Now, 19 years after organizing Allied Oil Co., Inc., with W. W. Vandeveer, who is on leave as PAW's District 2 director-in-charge, Mr. Newman has written the story of his experiences in the first world war for Allied's growing organization. His story, published in *The Allied Private,* is essentially the story of handling the petroleum products which helped push the American Army over the top in France.

Four Years in Shanghai

Mr. Newman was born in Michigan in 1890, then his parents moved to New York. He attended school there and graduated from Cornell University in 1912. In that year he went to work for Standard Oil Co. of New York, in Shanghai, China, where he spent four years. Returning to the U. S. he joined the old American Petroleum Products Co. at Cleveland, and the following year went to war.

"As sometimes happens," he wrote, "I was assigned to duties which were not altogether new to me."

First came assignments in Washington and New York for about a year in the procurement of petroleum products for



PLATT'S WAR-OIL DIRECTORY CONTENTS

(Partial List)

Government War-Oil Agencies

(Official and Semi-Official)

Petroleum Administration for War
Petroleum Industry Committees
Office of Defense Transportation
Office of Price Administration
Petroleum Industry War Council
Office of Rubber Director
Rubber Reserve Company
War Production Board

Other Government War Agencies

Army and Navy Petroleum Board
Defense Plant Corporation
Defense Supplies Corporation
Foreign Economic Administration
National War Labor Board
Reconstruction Finance Corporation
War Emergency Pipelines Inc.
War Manpower Commission
War Shipping Administration

Government Departments

Capital and Congress
Interior
Navy
United States Maritime Commission
War

Miscellaneous

American Petroleum Industries Committee
Interstate Oil Compact Commission Representatives
Members National Conference Petroleum Regulatory Authorities
Oil Company Representatives in Washington
Oil Associations in United States

Plus

Hotels Where Oil Men Stay
Phone Numbers Called Most Often

Girls!...

Is your "Chief" like this?

Does your "Chief" dictate miles of letters to you, mumbling the correspondents' names—'cause he can't make out their signatures—and then tell you to figure them out and get their addresses?

Has "He" said to you recently: "Now, I want you to put in all those new postal zone numbers so our mail will go through faster"?

Or, has THAT MAN ever said: "Haven't you reached my party on that long distance call yet?"

If your Boss is guilty of any of the above, we've got just the answer for you—the THIRD EDITION of Platt's War-Oil Directory.

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military uses. Then, early in 1918, he boarded the Leviathan, headed for France.

"Six of us 'gas and oil' specialists went over on the same transport, but I had a good break and was assigned to duty 'up front' while the other five had to be content with assignments in the 'service and supply' area," Mr. Newman continued.

"This was early in July, 1918, and at that time the First American Army was being organized for a drive which later developed into the Battle of the Argonne. U. S. troops had already fought along with the French and the British at Belleau Wood, Chateau-Thierry, and on the Marne, but for the first time the U. S. Army was ready to 'carry on' as a unit and under its own power and the whole area was surging with excitement and expectancy."

The Americans by then, Mr. Newman points out, were really on the march. A million men were being moved into front line positions and another million were scattered in the rear as reserves and in supply services.

Gasoline was going up to the front in barrels and cans—the British used cans of two Imperial gal. throughout the war and the favorite of the French was the *bidon*, a steel package of 13 liters (about 13 gal.). Supplies for U. S. troops were arriving by tanker at French ports including Bordeaux and Marseilles, and were being transferred to packages and moved up in carloads to Regulating Offices. John R. Kilpatrick, famous Yale end of the early 1900s and then a major, was in charge of the Regulating Office at Saint Dizier and Lieut. Newman had charge of the gasoline and oil branch. The job was to re-consign the carloads to rail heads nearer the front.

Lieut. Newman's only piece of equipment when he moved up to Auzeville to organize a bulk gasoline distribution depot was a light Dodge delivery truck, pictured above

Empties Left in Ditches

While the French and British systematically returned packages, Americans didn't. "You guessed it with respect to the Americans—the empties were being abandoned in ditches or wherever they had been emptied and dropped and were not being returned hence a critical gasoline shortage was impending," Mr. Newman wrote.

"One night Maj. Kilpatrick (now back in service as commanding general at Hampton Roads, Va.), called me in and said: 'Newman, I have arranged for 20 tank cars of gasoline—these are the new tank cars which have just been assembled at Bordeaux—to be at Auzeville early tomorrow morning and I have taken 20 tank trucks out of the fresh water service and am arranging for them to be there, too. I want you to go up there and unload the gasoline into the trucks and to carry on.'

"'All right, major, and how about some men and equipment?'

"'I am assigning you a light Dodge delivery truck with a driver and he can help you, but I'm sorry there isn't any equipment. Maybe you can find something when you get up there.'"

So far, Lieut. Newman had been reconsigning carloads of packages; now he was to move up two kilometers (about a mile and a half) behind the lines and organize a bulk motor gasoline distribution depot.

"So I proceeded to Auzeville," Mr. Newman wrote, "and sure enough the 20 trucks arrived early the following morning. Fortunately the tank cars of gasoline were a day late, which gave me and the Dodge truck driver one day to find and improvise some pumping equipment. We located three small trench pumps (with rubber packings for pumping water) at a French engineering dump and we also located a dozen or so 20 ft. lengths of 2-in. hard rubber hose at an abandoned German dump, and found some hand buckets. This was the equipment we had available to start unloading the tank cars when they arrived the following morning.

"Fortunately, the tank trucks had two drivers each, which provided some additional but unwilling and far from cooperative manpower. For seven days and seven nights we syphoned, bailed, and pumped gasoline; that is, when the pumps were not out of service being repacked with 'emergency' rubber packing. We had no connections and needed none. We placed the suction hoses through the dome covers of the cars and went to it. Looking back at it now, it seems that almost as much gasoline went onto the ground as went into the tank cars.

English Pumps to Rescue

"But this was in the days of high initial and high end point and it was a good thing the volatility was poor—naturally, the fire risk was terrific and we had no fire protection. Incidentally, we were shelled out the second day and retired about six kilometers to Souilly-sur-Aire.

"But finally the last tank car was emptied and we had a day to repair and recondition our equipment before the next shipment arrived. Also just at this time a squad of engineers reported, together with two carloads of English hand-pumping equipment. They were 4-in. pumps if I remember correctly and they really could pump!—provided a good husky pumper was on the power end.

"The tank trucks were mostly trucks, not so much tanks. They were built on White chassis and were originally in water service. Each chassis carried three small tanks, each 250 gal., total, 750 gal. per truck and what they lacked in capacity they made up in speed. They really could travel!

Slept In Boxcars

"Incidentally, we had no storage tanks, the gasoline was pumped directly from the tank cars into tank trucks—a truly mobile bulk station which moved with the combat Army.

"We were on 'detached service' and were strictly on our own. For months I received neither orders nor written instructions. As the gasoline came up we handled it and distributed it. Additional men joined my outfit from time to time and additional equipment arrived. We had to work out our own mess and billeting arrangements. We quartered ourselves in small French boxcars, the '40 hommes 8 chevaux' variety. We converted one of these vehicles into a mess car. We were truly self-sufficient and had to be. One of our men was assigned as commissary agent and another dealt in 'specialties' (canned tomatoes, canned peaches, chocolate bars, cigars, cigarets, etc.) and in explanation of this latter, keep in mind that we were the only source of motor gasoline in the entire combat area, and I have always been of the opinion that my men indulged in some good trades at the expense of the Red Cross, Y.W.C.A., K. of C., and the Salvation Army.

"We were always close enough to the

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front to experience all the thrills of combat warfare but were far enough back to get a true perspective of what was going on. The Battle of the Argonne was an epochal conflict and of course we Americans have always claimed it was the decisive battle of the War.

"At the time of the Armistice we had about 80 men in our detachment—pumpers, mechanics, cooks, 'specialists', etc. Due to the fact that the American offensive area had become greatly extended, it was necessary to divide our men and equipment into two separate groups and we were operating two stations instead of one. Our total fleet of tank trucks had grown to 120 and we were handling about 100,000 gal. of gasoline per day, which seemed like a prodigious amount of gasoline at the time. We also handled motor oils, but no aviation 'gas'.

"At 11:00 a.m. when the firing ceased the tension broke, but that was all, at least for the moment. Loaded trucks and tractors continued to move up and empty equipment came back. The field ambulances the same. Within three or four days, however, a letup was noticeable and soon plans were under way to organize the Third American Army, which soon came to be known as the Army of Occupation.

Third Army Organized

"During the Argonne Drive, the American First Army had advanced their positions about 40-60 kilometers and when the Armistice was declared we Americans were occupying the western portions of the province of Lorraine and were just ready to move eastward into the Duchy of Luxembourg.

"The entire area was a veritable No Man's land. No animals, no people, nothing but stark desolation.

"Our gasoline stations were at Dun-sur-Meuse and at Longuyon. This latter point was about 15 kilometers from the Luxembourg border. The plan was to organize the American Third Army from units of the First Army and also the Second Army which had been in the process of organization. The Third Army was then moved about 60-80 kilometers east—up to the German border and according to the terms of the Armistice was to be ready to move into Germany Dec. 1.

"Our Gas and Oil Detachment was moved up with the Third Army. We thought that 40 tank trucks and 40 men would do the job, and the remaining men and truck equipment were released. The two stations which we had been operating for several weeks were merged into one. About ten days were required to rest the men and recondition the equipment and we started to move about Nov. 20.

"We soon found that we had underestimated the number of men and tank trucks required. Our communications were poor—inadequate field telephones and verbal messages—but our detachment was able to pick up two motorcycles before we started on our march, whose drivers acted as couriers, and I don't know how we would have gotten along without them.

"As soon as we got into Luxembourg we were dependent on German railway personnel for moving our tank cars. This was all according to the plans laid down in the Armistice. The Germans had a bad habit of misunderstanding our instructions with respect to movement of loaded tank cars and empties, but possibly there was some misunderstanding on our side as well. What usually happened was that the German train crew—and there seemed to be only one crew in the entire area—would drop off our loaded cars of gasoline at the wrong station. Then our motorcycle men would have to search hours and hours for the engine and the crew in order to effect delivery as required. Then we would have to settle with the crew with cigarettes or soap or chocolate . The 'working stocks' of these commodities which we had accumulated back in France from the Red Cross, Salvation Army, K. of C. and Y. M. C. A. served an important part in getting the Third Army into Germany.

"But I remember one occasion when we completely lost three tank cars of gasoline just when they were most badly needed. We finally found the cars on a siding midway between two local stations. But there was no road or highway for our tank trucks, and we simply could not find hide or hair of the train crew. They had done a good job of making themselves scarce.

"So we finally drove our Dodge 'pick-up' down the track and one by one we attached a tow-line to the cars and with the rest of our detachment working on pinch bars and 'heaving ho' we finally moved them to the nearest team track siding and proceeded with the unloading. That was one occasion when our strictly portable equipment held a decided advantage.

"But the march to the German border was not all hardship. There had been no fighting in the Duchy of Luxembourg and life was going on about as usual. The country was very scenic.

Move Up to Border

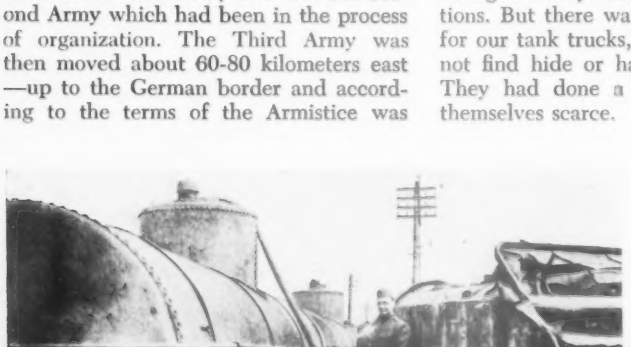
"One of the high points of my entire war experience was a few days in the small town of Berchem near the city of Luxembourg, where we had set up our portable station. The railroad station master, who spoke a little English, invited me to leave my '40 hommes and 8 chevaux' quarters and to stay in his house, which was over the railroad station, and I accepted. Of course he and his family might have heard about our supply of soap, cigars, chocolate, etc. and if this was the case naturally I could not disappoint him, and I did not.

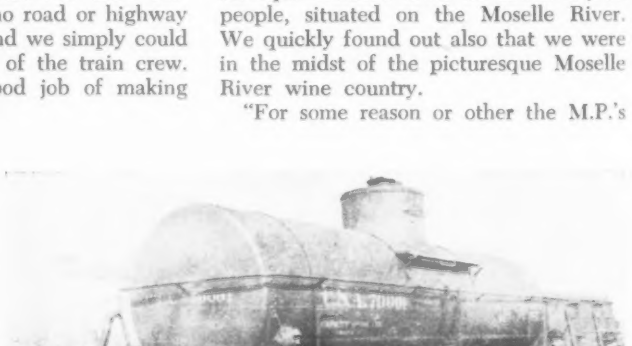
"As I recall we stayed in Berchem about four days, and then on Nov. 30, the last day of the month, we moved up to the border ready to move into Germany immediately after midnight.

"We moved in on schedule and our detachment had the distinction of taking the first train of American supplies into Germany. We had about ten tank cars of gasoline, two or three carloads of lub. oil in drums and barrels, about four carloads of men and about three or four carloads of equipment, altogether a 'gas and oil special' of about twenty cars.

"It was only about 10-12 kilometers from the border of Trier, our first station in Germany, and we arrived very early in the morning, long before daylight, on Dec. 1. We immediately set up our equipment and went to work. When daylight came we found that we were in a picturesque German town of about 75,000 people, situated on the Moselle River. We quickly found out also that we were in the midst of the picturesque Moselle River wine country.

"For some reason or other the M.P.'s





Left—Unloading a tank car at Auzeville with an English hand pump, which worked pretty good when a strong arm was on the business end of the handle. Before the pumps arrived, the cars had been "syphoned and bailed . . . for seven days and seven nights." Right—A tank car being unloaded by gravity, a stunt worked out when the "gasoline office" moved up to Trier

Give him the answers before it's too late!

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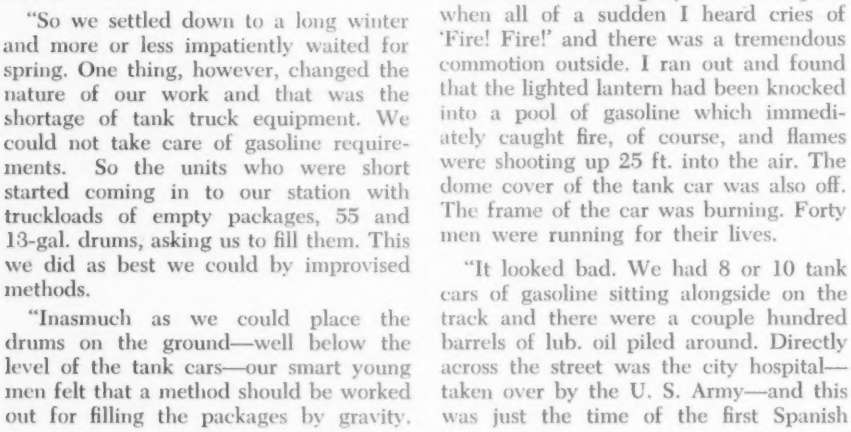
did not take over Trier for two weeks or so and by that time my men had become pretty well acquainted. They really were entitled to relaxation after five months of almost incessant night and day activity, and again with supplies of chocolate, etc., my boys really enjoyed the December holiday season. As I remember they made the available supplies just about last through New Year's.

"So we settled down to a long winter and more or less impatiently waited for spring. One thing, however, changed the nature of our work and that was the shortage of tank truck equipment. We could not take care of gasoline requirements. So the units who were short started coming in to our station with truckloads of empty packages, 55 and 13-gal. drums, asking us to fill them. This we did as best we could by improvised methods.

"Inasmuch as we could place the drums on the ground—well below the level of the tank cars—our smart young men felt that a method should be worked out for filling the packages by gravity. First, by using the facilities in a neighboring German machine shop, they drilled the bottom caps on the outlet legs of the tank cars and fitted in nipples and attached lengths of hose. This worked all right but was too slow, as only one package could be filled at a time. Next, Private John Faber from Buffalo, N. Y., designed a manifold arrangement with valves, etc., to load seven drums at a time.



Part of the stores of lubricating oil piled up at Bendorf after the Third Army moved into Luxembourg. Later, under the hot sun, barrels dried out, split and leaked. While Army's demands for petroleum declined, more kept arriving

Handling a Crisis

"This brought on the most serious crisis of all our experience. Private Faber had worked out the arrangement at the local machine shop—this was soon after Jan. 1, 1919—and took delivery in our Dodge truck late one afternoon. He was naturally impatient to see how it would work out and he was attaching the gadget to the outlet leg of a tank car just after dark. He had two or three men helping him and there was a kerosine lantern sitting on the wooden frame of the tank car. Unfortunately there had been considerable spillage and gasoline pools were all around.

"This was about 7:00 p.m. and I was in the mess car eating my steak and spuds when all of a sudden I heard cries of 'Fire! Fire!' and there was a tremendous commotion outside. I ran out and found that the lighted lantern had been knocked into a pool of gasoline which immediately caught fire, of course, and flames were shooting up 25 ft. into the air. The dome cover of the tank car was also off. The frame of the car was burning. Forty men were running for their lives.

"It looked bad. We had 8 or 10 tank cars of gasoline sitting alongside on the track and there were a couple hundred barrels of lub. oil piled around. Directly across the street was the city hospital—taken over by the U. S. Army—and this was just the time of the first Spanish flu epidemic and the hospital was full of American doughboys.

"In the railroad yards alongside there were several hundred cars of American supplies—food, clothing, forage, equipment of all kinds. I had visions of the whole place going up. I shouted for help and Pvt. John Peters responded. He was the only one—the others were 'gone from there' and I didn't blame them, but Peters and I went for the shovels and the sand barrels and we shoveled as no two men ever shoveled before. It seemed like hours but I don't suppose it was more than two minutes, and we put out the fire. Soon the rest of my detachment started to drift back although it was two days before the last two showed up. They were even more afraid of coming back and facing the music than they had been of the fire itself.

"All this time we were still pumping by hand and loading packages by gravity. Every so often I wrote a request for motor pumping equipment but none ever arrived. By March it began to look as if we were going to be in Germany for a long time, so I resolved on no more delay. With the Dodge truck and one man and a plentiful supply of gasoline, I started back toward France determined on coming back with motor equipment or know the reason why.

"We went first to Tours, Q.M.C. headquarters for the A.E.F., and we found no end of equipment—just what we were looking for. Just why we had never been able to get such equipment without personally commandeering it I never found out. Anyway, we returned quickly to Trier and installed the equipment and from then on we really led the 'life of Riley.'

"Soon after this—about April 15—it was determined that we should move up to the Rhine and take over the bulk river terminal of the Deutsch-Amerikanische Petroleum Gesellschaft at Bendorf about eight kilometers below Coblenz, so I left a lieutenant in charge at Trier and proceeded to Bendorf with about two-thirds of our detachment and most of our equipment.

"At Bendorf-on-the-Rhine we had three or four sizable storage tanks, about 25,000 bbls. each, also power plant, warehouses, machine shop and a complete terminal layout.

"No sooner had we taken over the terminal at Bendorf than motor barges started to bring up bulk gasoline which had been transshipped at Rotterdam, and bargeload after bargeload of lub. oil in drums, wooden barrels and cases arrived. It was funny, back in France when the war was on we never knew whether our supplies would be adequate—we were almost always down to our last tank car whenever a new shipment arrived. Our stock position improved comfortably at Trier, but at Bendorf! In no time at all our big gasoline storage tanks were full and the bargeloads of lub. oil continued to arrive! We filled our warehouses and all our available open yard space was piled full. We were soon overflowing onto adjoining property. All we could do was pile the barrels and cases in the open as best we could. We were able to procure a few tarpaulins but the supply was soon exhausted. And that was not all! As the weather started getting warmer, the barrels started drying out, the oil thinned up, and leakage started. We had no cooperage tools and all we could do was let it leak.

"Finally, in desperation I went to the Army headquarters in Coblenz and told my story. I didn't get much sympathy but they finally made arrangements to requisition some German civilian coopers and laborers who were assigned to me and paid by the Army of Occupation.

"By this time the American troops in the occupied area were well-settled and there was little movement, particularly by trucks and tractors, so our gasoline handling was at a minimum. The same

with lub. oil consumption. However, the barges still kept arriving with oil and we kept coopering and reconditioning, and piling and unpiling and piling again as best we could. All this oil came from the U. S. By June we had untold thousands of barrels on hand. Naturally the leakage was tremendous.

"Incidentally, there was no accounting of any kind, either incoming or outgoing. This was true of our operation right from its inception in July the year before. I will make this exception—we did get receipts for deliveries to other than Army units—that is, to the Y.M.C.A., K. of C., Red Cross, and Salvation Army. It was truly a bulk station manager's dream—no paper work, no reports, no accounting! Similarly, we drew our food rations and supplies from the nearest Q.M.C. station, just went after them and took delivery—never even had to sign a delivery slip. They figured that if we didn't need the supplies we wouldn't have gone after them.

"By the middle of June I was beginning to wonder just how long I was going to stay in Germany. I was still on detached service and had no way of getting relieved. I found out that the office to which I had been first assigned in France had long before been closed up and the officers and staff had gone back home. Prospects looked very bad indeed. But just then efforts through Congressional channels, which had been initiated several months before by my family and former employers bore fruit and I received a written order to turn my assignment over to the next in command and to proceed at once to Brest, France, for embarkation to the good old U.S.A.

"I left Bendorf soon after June 15 and I have often wondered what became of those thousands and thousands of barrels of lub. oil. Did all the oil leak? Or was it sold to the Germans or was it pilfered, or was it abandoned, or what? I am quite sure of one thing—none of it was ever shipped back to the U. S.

Used Passenger Car Rationing Reported Under Study by OPA

NPN News Bureau

WASHINGTON — The rationing of used passenger cars and establishment of ceiling prices for them are definite possibilities but both questions are now merely in the discussion stage, an OPA spokesman told NPN Dec. 30.

Buys Allied Gathering System

NPN News Bureau

TULSA—Oklahoma Pipe Line Co., subsidiary of Standard Oil (N. J.), has bought Allied Pipeline Corp.'s gathering system in the Pickens field of Madison and Yazoo counties, Miss. The purchase included 13 miles of line, storage facility and a 20-car loading rack situated on the Illinois-Central Railroad near the town of Pickens.

Oklahoma Pipe Line Co. will establish a district office in Jackson, Miss. Dallas Luttes, formerly division engineer at Wewoka, Okla., will be in charge.

Success on the fighting front depends to a great degree on how well truck transport performs on the home front. Trucks must not break down at a time when they are so urgently needed to haul the food and materials that will help win the war. The P.M. Service that GMC dealers pioneered long before the war is just the service that will help keep your trucks rolling during these critical times. The start of the New Year is the right time to start taking time out for regular visits to your GMC dealer . . . to take advantage of his proved time-saving, money-saving, truck-saving service!

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GMC TRUCKS

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BOYD OUTLINES OIL'S '44 PROSPECTS

(*Continued from p. 3*)

nesium, explosives, etc., and the result is that the U. S. will probably strain its productive capacity in 1944 and still be unable to produce enough oil to supply both our war machine and to reasonably satisfy our civilian requirements.

"The facts are simple and should be clearly understood by everyone who cannot get the quantity or quality of gasoline or oil that he would like. A year ago we had only about 1,700,000 men overseas, but by next July that number will have trebled to more than 5,000,000. Trebling our overseas army obviously trebles the requirements for fighting oils. Can our oil production be trebled or even doubled? Not a chance.

"In 1941 our crude oil production amounted to about 1,402,000,000 barrels; in 1942 not quite so much, and in 1943 our straining 405,000 wells produced only about 1,500,000,000 barrels, an increase over 1941 of only a little over 6% compared with the 200% increase in our overseas forces. And the Petroleum Administration for War says that at this late date it will be a miracle if the oil fields of the U. S. can produce throughout the year at the 4,707,150-barrels-a-day-rate required for January alone.

Crude Shortage Unescapable

"So after first building a vast new oil transportation system to replace the one that went to war, and then after building tremendous new refining facilities to turn out nearly one-third as much aviation gasoline as our entire peacetime production of all gasoline, we come face to face with the fact that we cannot produce in this country enough crude oil to keep both our military and civilian machines in high gear. The military machine must not slow down, so the civilian must.

"This situation means that during 1944 the primary cause of public inconvenience as regards oil will still be the war, but this year the secondary cause will be lack of crude petroleum which cannot be remedied as easily, or as promptly, or as cheaply as was the lack of transportation facilities in 1942, and the shortage of refining capacity in 1943. New oil fields simply cannot be found by the same procedure that builds pipelines, tankers and refineries.

"Part of the answer will be found by drawing on all possible foreign sources for some of our military requirements as well as for some of our civilian needs.

"Another part will be found in the drilling of more than the 1943 total, of nearly 19,000 wells in known oil fields of this country, and in the search for new fields. But it now appears that most of the answer, particularly on the West Coast, which is already importing oil from Texas, must be found in the reduction of both the quantity and quality of civilian gasoline.

"Don't forget that our average fighting man overseas requires his weight in oil every three days to get him there, keep him going and protect him overhead. And remember also that it takes an average of three tons of 100-octane gasoline to deliver and drop one ton of bombs. Think of that when you read of 2000 tons of bombs being dropped on German and Japanese objectives and hope that there will be an ever-increasing tempo of such savage blows until the enemy is crushed and you can once again drive into the gasoline station and say with confidence and certainty: 'Fill 'er up'."

Acquires Rincon Oil Interest With Texas Ranch Purchase

Special to NPN

HOUSTON, Tex. — George Echols, Houston independent oil operator, has purchased the Double D ranch in Starr and Hidalgo Counties in the Rio Grande Valley from Mr. and Mrs. Dee Davenport of Mission, Tex. The ranch covers about 22,500 acres.

Mr. Echols also purchased Mr. Davenport's one-sixteenth overriding royalty interest in 10,000 acres in the big Rincon oil pool in Starr County.

Total consideration in both purchases was said to be about $2,000,000.

Buys Circle Oil Interests

Special to NPN

HOUSTON, Tex.—J. B. Stoddard of Dallas has purchased all of the stock of the Circle Oil Co. of Houston for a reported cash consideration of $1,500,000. The Circle company's 52 wells in Texas, Oklahoma and Louisiana have an estimated reserve of 40,000,000 barrels. Offices of the company will probably be moved to Dallas. The company was headed by R. D. Farish of Houston.

Independents Should Ask OPA for Protection Against Its Employes

(*Continued from p. 16*)

it clear that he, at least, is just about going the limit against the Independent oil companies in these particulars.

Down at Indianapolis last month one of OPA's hearing administrators ruled that—

> "The Commissioner cannot find other than that the respondent (an Independent oil company owning and operating directly its stations) is chargeable with the acts of those employes in which it delegates the authority to handle this rationed commodity, to-wit; gasoline, and that when they do delegate this authority to their employes, the responsibility is wholly upon the company so doing."

So the hearing administrator suspended the company's station for 30 days despite the fact that the testimony showed that the station employes had been instructed to the contrary. In fact the OPA attorney seemed only concerned to show that the guilty employe was actually the "manager" of the station. This hearing commissioner, or administrator or "Kangaroo Court Judge", whatever you may call him, showed not the slightest interest in punishing the guilty employe, yet had that employe violated most any other law, against an individual or government on the premises of the employer, the police and prosecuting attorneys would have been hot after the guilty employe; in fact, would have taken the lead in bringing such an employe to justice and not even waited for the action of his employer.

The fact that such an employe was "manager" of a department would not have resulted in punishment for the crime being placed on the employer except there had been conclusive proof of the participation by the employer in the crime. And even then the punishment would not have been placed exclusively on the employer but upon all who took part in the crime.

As OPA launches on its fight against counterfeits there will be many opportunities of unfairly and illegally holding the oil companies responsible when they are doing their best to get good employes and make them obey the laws. There will also be many opportunities, if the OPA Chicago attorney is any authority, for penalizing companies for failing to spot counterfeits that only experts in a laboratory can identify. Hence the Independents should be alive to their danger.

It is a danger to Independents, rather than to the majors, because most Independents operate some or all of their own stations while only two or three majors do the same and then only a few hundred stations. It is pointed out that OPA took the plan for this present campaign up with the PAW National Marketing Committee and got no objections. Obviously not, for the complaint of the Independents has been that the members of most such committees are major company men who, in such cases as these, have not shown any particular concern for it is not their stations that get closed up but their dealer's, and they always have more dealers down the street. But not so the Independents.

There are still OPA attorneys and "kangaroo court judges" who show no signs of wanting to be fair especially to the small oil man who is not well equipped with good lawyers who will fight back. It will take the present new management of OPA a while longer probably to clean out these biased employes.

In the meantime the Independent oil men should join in getting from OPA at Washington clear and fair instructions to OPA branch employes to try and obviate the injustices which have been inflicted on the Independents in the past.

Radically Designed Motors for Smaller Cars Using 50% Less 'Gas' Forecast by 1953

NPN News Bureau

NEW YORK — A great American air transportation fleet, light-weight cars giving twice the present gasoline mileage and radically new types of power plants were predicted for the U. S. by 1953 by Dr. Carlton H. Schlesman, research and development head of Socony-Vacuum Oil Co.'s general laboratories, who addressed the New York Kiwanis Club here Dec. 29. He said the U. S. would have the greatest air-borne transportation fleet in the world by 1953, with 4000 planes available of which 3600 would be in daily operation. Direct employment for this fleet will require 12,000 men for flying crews, 18,000 for relief flying crews and 36,000 ground and service personnel.

"Such a fleet," he said, "would carry 90,000 passengers daily for a total of 50,000,000 passenger miles. In addition 5,000,000 ton-miles of freight would be flown every day. An operation of this kind would require 3,000,000 gals. of aviation gasoline and about 100,000 gals. of lubricating oil daily."

Dr. Schlesman was less optimistic about private flying. He said, "When peace comes our 185,000 war-trained pilots will have to pass through a period of readjustment. Very few of them will have the money to buy a private plane or have the opportunity of flying one."

"The 1953 passenger car," said Dr. Schlesman, "will be light in weight with a small cylinder, high compression engine using half the gasoline and oil of today's cars. But the car will be as commodious as present automobiles. Better streamlining and more practical design will keep it roomy. Alloy steels, aluminum and plastics will be used to keep the car light in weight, but with great rigidity, with the virtual elimination of the frame."

Improvements will permit the engine designer, he said, to plan a power plant that utilizes full power potential. "The 1953 engine will allow sustained speeds of 60 miles an hour. Lower wind resistance due to body design will require engines to develop only 35 m.p.h. at such speed and these same engines will run economically at the average city traffic speed of 30 miles per hour," Dr. Schlesman said.

"Such improvements as automatic transmission and automatic starting systems to eliminate idling will mean one-half the gasoline consumption per mile of our present models. Additional fuel saving will be made possible by increasing the compression ratio of the 1953 high speed, small cylinder engine. We can do this without exceeding 90-octane number in the 1953 fuel."

Dr. Schlesman sees "a practical compromise" between today's and the future octane rating and disagreed with some authorities that so-called special gasoline will reach nearly 100-octane.

As for lubrication, he said "We cannot say now that the 1953 car will be lubricated with petroleum oil. Some very stable chemical may have taken its place. A more radical thought is that

Dr. Schlesman

engines may be redesigned to operate on a water-base emulsion of the soluble oil type."

"The possibilities of increasing efficiency by further elevating the octane number of the fuel are of course already recognized, but a word of caution should be dropped in this connection; it is just as practicable to design the car of tomorrow to operate at high efficiency on fuels of zero octane number (as of 100 octane number).

"High efficiency prime movers which are free from the requirements of high octane number fuels may be built in three ways.

"First, by use of modified cycles of operation. Diesel-powered trucks and buses are already giving a good account of themselves and we may expect such use to increase. . . . .

"Second, the use of continuous combustion systems. A steam-driven automobile can be operated on fuel of any octane number. Similarly, turbine systems lend themselves to the use of fuels of low octane. For example, the fuel might be burned in flame at high pressure. Under these conditions, detonation is not a serious problem. . . .

"A third and far more radical power plant is one already under development in which the fuel is burned inside of gas mantels so that radiant energy is produced at high efficiency. This energy impinges on photo-electric cells which convert it into electrical energy. This electrical energy is then employed to drive electrical motors located at the wheels. It is interesting to note that one of the important missing links in this evolution, the light-weight, high-powered electric motor, is now available for the first time."

Here is a motor oil on which you can build substantial business. It's genuine Freedom pedigreed, 100% Pure Pennsylvania and has the outstanding reputation of turning hundreds of thousands of purchasers into permanent customers . . . On glass, cans or any other container, this label means business . . . Write for information on exclusive territories.

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PACIFIC COAST BULK PLANT AND WAREHOUSE
Los Angeles, California

WAR ORDERS FOR OIL INDUSTRY

(*Continued from p. 14*)

nor another producer be able to render same service with lesser amount critical material, nor a stand-by service created, and no release is implied from U-7's restrictions nor L-174's. (Natural gas and manufactured gas limitation orders).

CONSTRUCTION AUTHORIZED BY L-41 GAS CONNECTIONS—Supp. Utilities Order U-1-d, as am. 12-10-43—Industrial and commercial consumers' extensions must use smallest sizes and quantities of equipment required to furnish service at minimum standards. Domestic consumers' extension must be within limits established by WPB Housing Utilities Standards, and all consumers are subject to total cost limitations and service duplication restrictions as stated in U-1-a, *above*. Producer must file Form WPB-3348 for filing with builder's L-41 application. No release from U-7 nor L-174 restrictions. Issued 12-10.

EXTENSIONS OF GAS FACILITIES—Supp. Utilities Order U-1-f, as am. 12-10-43—U-1-d or U-1-h apply to construction of utility facilities where construction or remodeling by consumer is involved for which specific WPB authorization has been issued. Cooking appliance connections can be made only if dwelling unequipped with any range and neither electric nor gas facilities are installed, except that extensions may be made to serve a gas or electric range previously used by consumer in another dwelling. Industrial and commercial consumers must be engaged in business listed in Schedules I or II of CMP 5; or must be certain public utilities; or engaged in the petroleum industry, except in retail marketing, as those terms are defined in P-98-b.

Also listed are mining, burning refractories (with serial number under P-56), radio communication or broadcasting, schools, churches, hospitals: Limits of Utilities Construction Standards (Schedule I) apply, and all cost and service restrictions cited in U-1-a and U-1-d (above) apply. Schedule I limits pipe to cast iron or non-metallic, and steel pipe only for specified safety reasons for mains over 4" diameter, and any type pipe for mains 4" diameter and smaller and for all service connections.

Commercial and industrial extensions are limited only to the smallest sizes and quantities of equipment required to furnish service at minimum standards. Gas or central steam heating service limited to 400 lbs. steel pipe or 1800 lbs. cast iron pipe, or a combination of not over 400 lbs. steel and 1800 lbs. cast iron pipe, this quantity cast iron pipe to be diminished by twice the weight of steel pipe used. Non-metallic pipe permitted in lengths not greater than length which would be installed if cast iron pipe were used. Issued 12-10.

COPPER TUBING FOR HEATING EQUIPMENT DISTRIBUTORS' REPAIRS—CMP 9A, Direction 1—Distributors of automotive equipment, and heating equipment (gas or oil burning) in business on 8-1-43 and who sold copper tubing for repairs in 1941 may obtain copper tubing to sell to repairmen only, for use in repairing such equipment, up to 6000 lbs. per quarter, by endorsing orders with allotment number V-3 and the CMP 7 certification. Additional amounts may be obtained upon letter-application to nearest WPB Field Office. Inventories may not exceed 30-day supply, unless small-order practice of producer raises inventory above that amount. Issued 12-22.

WHAT CONSTITUTES REPAIR PARTS—CMP 9A, Interp. 1—AA-3 rating to repairman to buy repair parts for his work does not apply to any complete item ordinarily used by itself. Grates, but not complete furnaces, may be bought by repairmen under this rating. Issued 12-15.

PRODUCTION MATERIALS FOR PRODUCTS NEITHER IN CLASS A NOR B—Pri. Reg. 11 B, as am. 12-21-43—Application for priorities assistance for obtaining materials to manufacture unclassified products may be made on WPB-2613 (old PD-870), subject to production rate permitted under any existing limitation and other orders of WPB. If such assistance is obtained manufacturer may not extend ratings received from customers to purchase materials for same product during the quarters covered, except for AAA orders and orders already rated by other applicable WPB regulations. Assignments of rating on WPB-2613 will include authorization of a production schedule for the product in question, setting a production maximum for the quarter. Definition of "production material" specifically includes material which at any stage of production enters into the chemical reaction necessary to manufacture of an unclassified product, or which is used as a solvent, wash, or extractant at any stage of the production of chemicals. Issued 12-21.

COMPRESSOR AND HEAT EXCHANGER ORDER DEADLINES—Pri. Reg. 18, Direction 1 Revoked—Deadlines for first and subsequent quarters of 1944 revoked. Issued 12-27.

Executive Orders

WAR MANPOWER COMMISSION — EO 9409—ODT given separate representation on WMC. Issued 12-23.

DIRECTOR OF SELECTIVE SERVICE—EO 9410—Selective Service System designated as a separate agency, under Director of Selective Service, control of War Manpower Commission over it abolished, and Director given President's powers formerly delegated to WMC head. Issued 12-23, effective 12-5.

Foreign Economic Administration

ASPHALT—General Regs. Am. 128—General License Group K assigned to all asphalt manufactures in the prohibited exportations list of Foreign Economic Administration. Issued 12-10.

Louisiana Allowable Set

BATON ROUGE—Louisiana Dept. of Conservation has set the January allowable at 369,101 b/d, 5159 b/d above the December allowable and 6599 b/d under the PAW recommendation. The allowable was split between North and South Louisiana fields, in the amounts of 76,605 b/d and 292,496 b/d, respectively.

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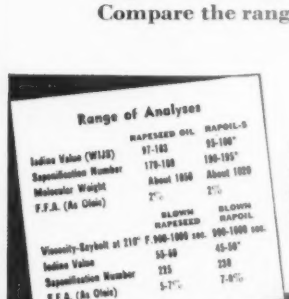
Has Everything that Rapeseed Oil Has --AND MORE

Rapoil-S is a domestic product and is not offered as a "substitute" because it has chemical characteristics that are superior to rapeseed oil. Its lower *I.V. insures less tendency to form sludge and its higher *saponification number indicates shorter chain length fatty acid radicles. Rapoil-S, with its larger molecular size and the triglycerides, gives the oil a high lubricating value or "greasiness" plus high surface wetting power and polarity. Rapoil-S has also been approved for maritime purposes. Compare the range of analyses of Rapoil-S to rapeseed oil.


Range of Analyses

	RAPESEED OIL	RAPOIL-S
Iodine Value (WIJS)	97-103	95-100*
Saponification Number	178-188	190-195*
Molecular Weight	About 1050	About 1020
F.F.A. (As Oleic)	2%*	2%*
	BLOWN RAPESEED	BLOWN RAPOIL
Viscosity-Saybolt at 210° F. 900-1000 sec.	55-60	45-50*
Iodine Value	225	230
Saponification Number	5-7%*	7-8%*
F.F.A. (As Oleic)		

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Coming Meetings

JANUARY

Society of Chemical Industry, American Section, Medal award dinner, Hotel Commodore, New York, N. Y., Fri., Jan. 7.

Society of Automotive Engineers, annual meeting and engineering display, Book-Cadillac Hotel, Detroit, Mich., Mon.-Fri., Jan. 10-14.

North Carolina Oil Jobbers' Assn., annual meeting, Hotel Carolina, Raleigh, N. C., Wed., Jan. 12.

Northwest Petroleum Assn., annual meeting, Nicollet Hotel, Minneapolis, Minn., Thurs.-Fri., Jan. 13-14.

Kansas Oil Men's Assn., annual meeting Hotel Broadview, Wichita, Kans., Mon.-Tues, Jan. 24-25. (Make reservations through K.O.M.A. headquarters).

FEBRUARY

Illinois Petroleum Marketers' Assn., 1944 Post-War Conference, Hotel Pere Marquette, Wed.-Thurs., Feb. 16-17.

American Institute of Mining and Metallurgical Engineers, annual meeting, Waldorf-Astoria, New York, N. Y., Sun.-Thurs., Feb. 20-24.

Iowa Independent Oil Jobbers' Assn., annual meeting, Hotel Fort Des Moines, Des Moines, Ia., Wed.-Thurs., Feb. 23-24.

MARCH

Empire State Petroleum Assn., Inc., spring meeting, Hotel Onondaga, Syracuse, N. Y., Wed.-Thurs., Mar. 22-23.

Market Reports

MID-WEST—Refiners and marketers carried on with little or no gasoline inventories to fill strong demand for gasoline last week. Kerosine and fuel oil call settled down to steady demand which absorbed all available quantities of these products. Refiners and marketers report, however, that they are in better position this season than last because of consumer storages filled before beginning of season, drop in shipments to East Coast and mild weather experienced first part of season.

Products shipments are falling farther behind each day and shippers are calling on ODT for tank car permits to alleviate partial breakdown of truck transportation because of shortage of parts, tire, and manpower. No change in prices of marketers or refiners reported during week.

* * *

PENNSYLVANIA—Early in the week, Penna. refiner reported raising his quotations 0.5c for 200 and 150 vis., 25 p.t. neutrals, to 32.5c and 30.5c, respectively. Other refiners continue to quote 200 vis. as follows: one at 28c, two at 29c, one at 30c, two at 31c, one at 32c and one at 32.5c. Price ranges now stand at 28-32.5c for 200 vis. and 26-30.5c for 150 vis. 25 p.t. Several refiners offered only limited quantity for sale at these prices. Industrial requirements were reported by many refiners to be absorbing production of burning oils and especially kerosine which is scarce in both fields.

* * *

ATLANTIC COAST—Refined products prices were reported firm and materials closely held. Gasoline and kerosine reported under heavy call as available supplies continue limited. Quotations at all points unchanged.

* * *

GULF COAST—Overall shortage of refined products continues and refiners report demand for all materials increasing. "Available supplies of residual oil are showing signs of reduction", reported several Gulf refiners, who said they had no surplus on hand. No price changes reported.

* * *

MID-CONTINENT—Demand for all refined products continues high, according to refiners' reports. A few say gasoline demand has eased some but not enough to allow them to begin building inventory. Refiners still report having to delay burning oil orders due to lack of material. Inquiries for residual fuel continue to come in but refiners say they can only refer them to S. & D. committee since their production is allocated to railroads.

Truck transportation situation is getting increasingly worse, refiners report. Kansas refiner said several transporters are so far behind with orders that they are unable to take on new business.

During the week 12 cars Grade 26-70 natural gasoline were reported sold at 4.75c f.o.b. Group 3, and 8 cars were reported sold at 4.375c f.o.b. Breckenridge.

Crude Prices

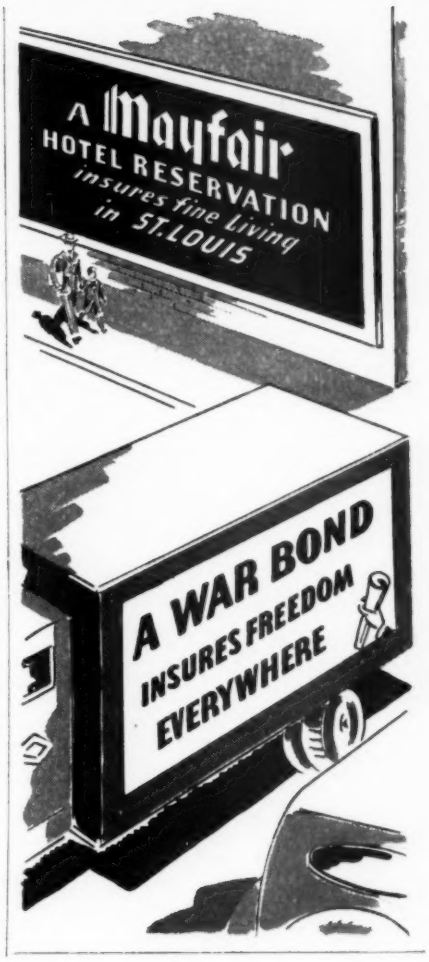
Since changes in crude oil prices are so few, the 2 pages of crude oil price tables hereafter will be printed only when there are sufficient changes in prices to warrant.

In the meantime a record is being kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to reglar subscribers. Changes in crude oil prices will be specially noted in this market section when made.

Crude Price Changes

Magnolia Petroleum Co. reported new postings for crude oil purchased in Lea County, New Mexico and West Texas counties of Crane, Upton, Howard, Glasscock, Mitchell, Whinkler, Cochrane, Hockley, Yoakum, Hines, Pecos and Andrews as follows: Below 20 gravity at 70c with 2c differential to 40 & above at $1.12, effective Jan. 1.

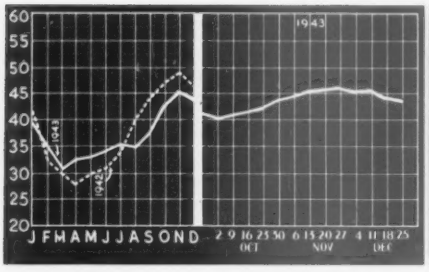
The Texas Co. posted same schedule as above for crude they purchase in West Texas and Lea County, New Mexico, effective Jan. 1.



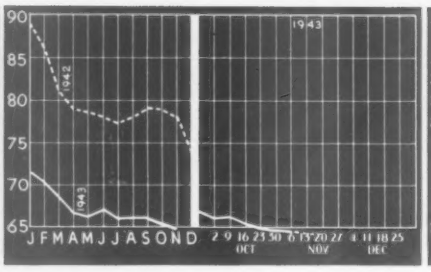
Summary of Daily Gasoline Prices (December 27 to January 3)

U. S. Motor (ASTM octane)	Monday Jan. 3	Friday Dec. 31	Thursday Dec. 30	Wednesday Dec. 29	Tuesday Dec. 28
76 octane Ethyl:					
Oklahoma	6.75	6.75	6.75	6.75	6.75
Mid-Western (Group 3 basis)	6.75 – 7.25	6.75 – 7.25	6.75 – 7.25	6.75 – 7.25	7
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7	7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7 (2)	7 (2)	7 (2)	7 (2)	7 (2)
72 octane:					
Oklahoma	6	6	6	6	6
Mid-Western (Group 3 basis)	6	6	6	6	6
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
63-66 octane:					
Oklahoma	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
Mid-Western (Group 3 basis)	5.6 – 5.625	5.6 – 5.625	5.6 – 5.625	5.6 – 5.625	5.6 – 5.625
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.75 (1)	5.75 (1)	5.75 (1)	5.75 (1)	5.75 (1)
60 octane & above:					
Oklahoma	5.25	5.25	5.25	5.25	5.25
Mid-Western (Group 3 basis)	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25	5.25
Motor Gasoline, 72 octane (ASTM)					
New York harbor	9.2 – 9.4	9.2 – 9.4	9.2 – 9.4	9.2 – 9.4	9.2 – 9.4
New York harbor, barges	9.1 – 9.3	9.1 – 9.3	9.1 – 9.3	9.1 – 9.3	9.1 – 9.3
Philadelphia district	9.2	9.2 – 9.7	9.2 – 9.7	9.2 – 9.7	9.2 – 9.7
Baltimore district	8.95	8.95	8.95	8.95	8.95
Motor Gasoline:					
Western Penna. Bradford-Warren:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.75 – 8.95	7.75 – 8.95	7.75 – 8.95	7.75 – 8.95	7.75 – 8.95
Western Penna. Other Districts:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 – 7.75	7.5 – 7.75	7.5 – 7.75	7.5 – 7.75	7.5 – 7.75

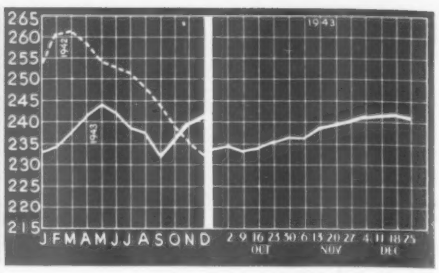
Gas Oil and Distillate Stocks



Residual Fuel Oil Stocks



Crude Stocks



Refinery Operations

(American Petroleum Institute figures in thousands of barrels of 42 gal. each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

Districts	Daily Potential Refining Capacity Week Ended Dec. 25	Daily Potential Refining Capacity Week Ended Dec. 18	Per Cent of Refining Capacity Reporting Week Ended Dec. 25	Per Cent of Refining Capacity Reporting Week Ended Dec. 18	Daily Average Crude Runs to Stills Week Ended Dec. 25	Daily Average Crude Runs to Stills Week Ended Dec. 18	Per Cent of Reporting Capacity Operated Week Ended Dec. 25	Per Cent of Reporting Capacity Operated Week Ended Dec. 18
Combined°°	2,444	2,444	88.7	88.7	2,111	2,110	86.4	86.3
Appalachian (Dist. No. 1)	130	130	83.9	83.9	92	97	70.8	74.6
Appalachian (Dist. No. 2)	47	47	87.2	87.2	52	41	110.6	87.2
Ind., Ill., Ky.	824	824	85.2	85.2	741	739	89.9	89.7
Okla., Kans., Mo.	416	416	80.1	80.1	328	328	78.8	78.8
Rocky Mt. (Dist. No. 3)	8	8	26.9	26.9	11	11	137.5	137.5
Rocky Mt. (Dist. No. 4)	141	141	58.3	58.3	97	88	68.8	62.4
California	817	817	89.9	89.9	753	732	92.2	89.6
Total U. S.—B. of M. Basis	4,827	4,827	86.4	86.4	4,185	4,146	86.7	85.9
U. S.—B. of M. Basis Dec. 26, 1942					3,508			

Districts	Gasoline Production at Refineries inc. Natural Blended Week Ended Dec. 25	Gasoline Production at Refineries inc. Natural Blended Week Ended Dec. 18	Stocks of Finished and Unfinished Gasoline Week Ended Dec. 25	Stocks of Finished and Unfinished Gasoline Week Ended Dec. 18	Total Stocks Gas Oil & Distillates Week Ended Dec. 25	Total Stocks Gas Oil & Distillates Week Ended Dec. 18	Total Stocks Residual Fuel Oil Week Ended Dec. 25	Total Stocks Residual Fuel Oil Week Ended Dec. 18
Combined°°	5,990	5,767	33,803	33,499	23,220	22,957	16,324	16,494
Appalachian (Dist. No. 1)	319	309	1,697	1,733	884	853	153	158
Appalachian (Dist. No. 2)	156	148	1,179	1,079	81	123	186	194
Ind., Ill., Ky.	2,505	2,396	14,544	14,115	6,145	6,136	2,780	2,677
Okla., Kans., Mo.	1,201	1,141	7,019	6,767	1,978	2,203	947	971
Rocky Mt. (Dist. No. 3)	35	29	69	67	21	22	31	29
Rocky Mt. (Dist. 4)	287	286	1,324	1,254	364	380	659	661
California	2,104	2,164	14,389	14,211	11,098	11,443	36,516	37,088
Total U. S.—B. of M. Basis	12,597	12,240	74,024°	72,725	43,791	44,117	57,596	58,272
U. S.—B. of M. Basis Dec. 26, 1942	10,047		77,781		45,414		72,943	

° Finished 63,633,000 bbl.; Unfinished 10,391,000 bbl.

°° Includes East Coast, Inland Texas, Texas Gulf, Louisiana Gulf, and North Louisiana-Arkansas districts.

Dist. 1 indices are: Gasoline 43.2%, Kerosine 52.9%, Gas Oil 80%, Residual Fuel Oil 66.9% of normal.

Crude Oil Stocks

(Bureau of Mines Figures in thousands of bbls.)

Grade or Origin	Dec. 25	Dec. 18	Change from Dec. 18
Penna. Grade	2,427	2,403	+ 24
Other Appalachian	1,588	1,661	— 73
Lima-Michigan	1,064	1,055	+ 9
Illinois-Indiana	12,584	12,247	+337
Arkansas	3,062	3,122	— 60
Kansas	8,008	7,888	+120
Louisiana	14,099	14,058	+ 41
Northern	4,566	4,634	— 68
Gulf Coast	9,533	9,424	+109
Mississippi	1,032	919	+113
New Mexico	7,913	8,061	—148
Oklahoma	32,917	33,310	—393
Texas	111,430	111,763	—333
East Texas	23,801	23,592	+209
West Texas	23,182	27,894	—4,712
Gulf Texas	32,934	33,453	—519
Other Texas	26,513	26,824	—311
Panhandle	6,375	6,475	—100
North	5,398	5,375	+ 23
South	5,722	5,843	—121
Other	9,018	9,131	—113
Rocky Mountain	11,547	11,725	—178
California	31,862	32,169	—307
Foreign	1,777	1,414	+363
Total gasoline-bearing in U. S.	241,310	241,795	—485
Heavy in California	8,116	8,047	+ 69

U. S. Crude Oil Production

(American Petroleum Institute Figures)

	WEEK ENDED Dec. 25 Barrels (Daily Average)	WEEK ENDED Dec. 18 Barrels (Daily Average)
Oklahoma	329,050	325,800
Kansas	269,900	271,800
Nebraska	1,600	1,600
Texas	1,894,700	1,894,700
Louisiana	353,550	354,050
Arkansas	79,200	78,200
Mississippi	47,450	47,600
Illinois	213,550	210,700
Indiana	13,250	11,850
Eastern (Ill., Ind. & Ky. excluded)	68,700	67,500
Kentucky	22,000	21,000
Michigan	50,800	53,100
Wyoming	86,100	89,500
Montana	20,350	20,350
Colorado	6,900	6,550
New Mexico	112,900	112,900
California	792,500	797,200
Total, United States	4,362,500	4,363,950

Pennsylvania Crude Runs

(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)

Week ended	Daily Average	Week ended	Daily Average
May 1	76,555	Sept. 4	72,236
May 8	77,088	Sept. 11	72,743
May 15	79,366	Sept. 18	75,420
May 22	76,684	Sept. 25	82,851
May 29	76,488	Oct. 2	72,485
June 5	71,505	Oct. 9	66,904
June 12	76,766	Oct. 16	69,008
June 19	68,115	Oct. 23	76,517
June 26	69,551	Oct. 30	76,641
July 3	68,542	Nov. 6	59,868
July 10	75,188	Nov. 13	69,133
July 17	73,156	Nov. 20	63,856
July 24	62,047	Nov. 27	71,950
July 31	64,011	Dec. 4	70,163
Aug. 7	57,594	Dec. 11	65,508
Aug. 14	67,191	Dec. 18	64,327
Aug. 21	79,917	Dec. 25	62,089
Aug. 28	78,000	1942 Low	67,243
		1942 High	87,251

N.P.N. Gasoline Index

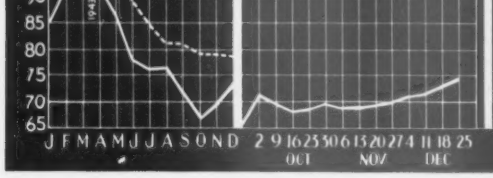
	Dealer T.W. Cents Per Gal.	Tank Car Cents Per Gal.
Jan. 3	10.43	6.64
Month ago	10.45	6.92
Year ago	10.32	6.60

Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

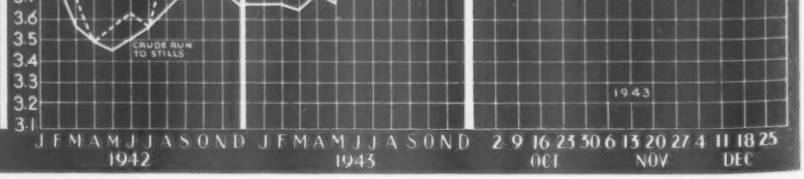
Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

Gasoline Stocks

(Finished and Unfinished)



Crude Production and Runs to Stills



OIL PRICE SECTION

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At Refineries and Terminals and by Tank Wagon

Prices herewith are reproduced from Platt's *OILGRAM* Daily Oil Price Service, associated with National Petroleum News, whose representatives in all *NPN-OILGRAM* offices devote their time exclusively to reporting oil industry prices everywhere.

Prices shown are actual sales prices, or quotations meaning sellers' general offers or posted prices; for current sales and shipment; for the business day or period stated; except Tank Wagon prices, prices are for bulk lots such as tank car and motor transport; barge or tanker cargo lot prices are identified; FOB refineries or terminals; in cents per gal. except where shown in bbls. of 42 gals.; ex all fees and taxes; for crude oil and its products lawfully produced and transported; reported as received by *OILGRAM* and National Petroleum News but not guaranteed; for subscribers' private use only and not for resale or distribution or publication. For further details of price conditions apply to any *NPN-OILGRAM* office or see back of any *OILGRAM* Price Service invoice.

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Refinery Prices

Gasoline —U. S. Motor (A S T M) except where otherwise specified

Prices in Effect	Jan. 3	Dec. 27
OKLAHOMA		
76 oct. Ethyl	6.75	6.75
72 oct.	6	6
63-66 oct.	5.625 (2)	5.625 (2)
60 oct. & below	5.25	5.25
60-62, 400 e.p.	5.25 (1)	5.25 (1)
MID-WESTERN (Group 3 basis)		
76 oct. Ethyl	6.75 – 7.25	6.75 – 7.25
72 oct.	6	6
63-66 oct.	5.6 – 5.625	5.6 – 5.625
60 oct. & below	5.2 – 5.25	5.2 – 5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl	7	7
72 oct.	6	6
63-66 oct.	5.625 (1)	5.625 (1)
60 oct. & below	5.2 – 5.25	5.2 – 5.25
60-62, 400 e.p.	5.375 (1)	5.375 (1)
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl	6.75 – 7 (2)	6.75 – 7 (2)
72 oct.	6	6
63-66 oct.	5.75 (1)	5.75 (1)
60 oct. & below	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
76 oct.	7 (2)	7 (2)
72 oct.	6 (2)	6 (2)
67-69 oct.	....	....
62 oct. & below	5.25 (2)	5.25 (2)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
60 oct. & below	No Price	No Price
60-62, 400 e.p.	No Price	No Price
KANSAS (For Kansas destinations only)		
76 oct. Ethyl	7.25-7.5 (2)	7.25-7.5 (2)
72 oct.	6.25 – 6.3	6.25 – 6.3
63-66 oct.	5.9 (2)	5.9 (2)
60 oct. & below	5.5	5.5
ARK. (For shipment to Ark. & La.)		
72 oct., leaded	6 (1)	6 (1)
70-72 oct. "	5.875 (1)	5.875 (1)
62 oct. "	5.5 (1)	5.5 (1)
60 oct. & below, leaded	5.5 (1)	5.5 (1)
WESTERN PENNA. (Motor gasoline)		
Bradford-Warren:		
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.75 – 8.95	7.75 – 8.95
Other districts:		
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 – 7.75	7.5 – 7.75

Prices in Effect	Jan. 3	Dec. 27
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor: (Oct. ASTM):		
72 oct.	8 – 8.5	8 – 8.5
67-69 oct.	....	....
Str. run gasoline, excluding Detroit shpt.	6	6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances).		
72 oct.	8.375	8.375
CALIFORNIA U.S. Motor:		
76 oct. (Ethyl)	7.5 – 8.75	7.5 – 8.75
70-72 oct. (regular)	6.5 – 7.75	6.5 – 7.75
65 oct. & below (3rd grade)	6.5 – 6.75	6.5 – 6.75

Kerosine, & Gas Fuel Oils

Prices in Effect	Jan. 3	Dec. 27
OKLAHOMA		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range Oil	4 – 4.125	4 – 4.125
No. 1 P.W.	3.875	3.875
No. 1 straw	....	....
No. 2 straw	3.625	3.625
No. 3 fuel	3.5 (2)	3.5 (2)
U. G. I. Gas Oil	....	....
No. 6 fuel	....	....
14-16 fuel	$0.97 (2)	$0.97 (2)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range Oil	4 – 4.1	4 – 4.1
No. 1 p.w.	3.875	3.875
No. 2 straw	3.625	3.625
No. 3	3.5 (1)	3.5 (1)
No. 5	$0.85 (1)	$0.85 (1)
No. 6	$0.80 (2)	$0.80 (2)
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w.	4.375 (2)	4.375 (2)
42-44 grav. w.w.	4.5 (2)	4.5 (2)
No. 1 P.W.	3.875 (1)	3.875 (1)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
42-44 grav. w.w.	4.5 (1)	4.5 (1)
No. 1 straw	No Price	No Price
KANSAS (For Kansas destinations only).		
41-43 grav. w.w.	No Price	No Price
42-44 grav. w.w.	4.625- 4.7	4.625- 4.7
No. 1 p.w.	4 – 4.1	4 – 4.1
No. 6 fuel	$0.85	$0.85
ARK. (For shipment to Ark. and La.)		
41-43 grav. w.w.	4.625 (1)	4.625 (1)
No. 1	4 (1)	4 (1)
No. 2	3.5 (1)	3.5 (1)
No. 3 fuel	3.5 (1)	3.5 (1)
Tractor fuel, for shpt. to Ark. points only	5.125 (1)	5.125 (1)
WESTERN PENNA.		
Bradford-Warren:		
45 grav. w.w.	6.55 – 8.05	6.55 – 8.05
46 grav. w.w.	6.675 (1)	6.675 (1)
No. 1 fuel	6.55 – 8.05	6.55 – 8.05
No. 2 "	6.625-7.625(2)	6.625-7.625(2)
No. 3 "	6.625-7.75 (2)	6.625-7.75 (2)
36-40 gravity	6.625-6.75 (2)	6.625-6.75 (2)
Other districts.		
45 grav. w.w.	6.75 – 7.925	6.75 – 7.925
46 grav. w.w.	6.875- 7.25	6.875- 7.25
47 grav. w.w.	7 – 7.25	7 – 7.25
No. 1 fuel	6.625- 6.75	6.625- 6.75
No. 2 "	6.5 – 7.125	6.5 – 7.125
No. 3 "	6.5 – 7.125	6.5 – 7.125
36-40 grav. Pittsburgh dist. prices excluded	6.5 – 7	6.5 – 7
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
47-49 gravity w.w.	5.8 – 6	5.8 – 6
P.W. Distillate	5.5	5.5
No. 3 gas oil, Straw	5	5
U.G.I. gas oil	4.5 (2)	4.5 (2)
Fuel Oils (*Vis. at* 100).		
300-500 Vis.	....	....
100-300 Vis.	4.5	4.5
OHIO (S. O. quotations for statewide delivery)		
Kerosine	7	7
CALIFORNIA		
40-43 grav. w.w.	5 – 7	5 – 7
San Joaquin Valley:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (2)	$1.20 (2)
Diesel fuel	4 (2)	4 (2)
Stove dist.	5 (2)	5 (2)

Prices in Effect	Jan. 3	Dec. 27
Los Angeles:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (2)	$1.20 (2)
Diesel fuel	4 (2)	4 (2)
Stove dist.	5	5
San Francisco:		
Heavy fuel	$1.15 (1)	$1.15 (1)
Light fuel	$1.25 (1)	$1.25 (1)
Diesel fuel	4.5 (1)	4.5 (1)
Stove dist.	5.5 (1)	5.5 (1)

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

Prices in Effect	Jan. 3	Dec. 27
WESTERN PENNA.		
Prices are for sales made, or offers reliably reported, to jobbers & compounders only.		
Viscous Neutrals—*No. 3 col. Vis. at 70°F.*		
200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.	35 (1)	35 (1)
10 p.t.	34 (1)	34 (1)
15 p.t.	33 (1)	33 (1)
25 p.t.	28-32.5	28-32
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.	33 (1)	33 (1)
10 p.t.	32 (1)	32 (1)
15 p.t.	31 (1)	31 (1)
25 p.t.	26-30.5	26-30
Cylinder Stocks		
Brt. stk., 145-155 *vis. at* 210°, 540-550 fl., *No. 8 col.*		
10 p.t.	30.5 (1)	30.5 (1)
15 p.t.	29.5 (1)	29.5 (1)
25 p.t.	25	25
600 S.R. filterable.	15	15
650 S.R.	15.5	15.5
600 fl.	16	16
630 fl.	17	17
MID-CONTINENT (F. o. b. Tulsa)		
Neutral Oils (*Vis. at* 100° *F. 0 to* 10 *P.P.*)		
Pale Oils:		
Vis. Color		
60-85—No. 2	8	8
86-110—No. 2	8.5	8.5
150—No. 3	14.5	14.5
180—No. 3	15	15
200—No. 3	15	15
250—No. 3	16-16.5	16-16.5
280—No. 3	17	17
300—No. 3	18	18
Red Oils:		
180—No. 5	15 (1)	15 (1)
200—No. 5	15 (1)	15 (1)
280—No. 5	No Price	No Price
300—No. 5	17.5 (2)	17.5 (2)

Note: Viscous Neutrals, 15-25 p.p. generally are quoted 0.5c under 0-10 p.p. oils. Non-viscous oils, 15-25 p.p.; generally are quoted 0.25c under 0-10 p.p. oils.

Bright Stock—*Vis. at* 210°		
200 Vis. D	27 (1)	27 (1)
150-160 Vis. D:		
0 to 10 p.p.	23	23
10 to 25 p.p.	22.5-23	22.5-23
25 to 40 p.p.	23 (1)	23 (1)
150-160 Vis. E	22 (1)	22 (1)
120 Vis. D:		
0 to 10 p.p.	22 (2)	22 (2)
600 S.R. Dark Green	8.5 (1)	8.5 (1)
600 S.R. Olive Green	10-11 (2)	10-11 (2)
631 S.R.	....	....
Black Oil	5.5 (1)	5.5 (1)

QUALIFYING PRICE NOTE: Prices on neutrals are posted prices from which refiners allow special discounts, ranging to 1c to meet varying local competition.

SOUTH TEXAS Neutral Oils		
Pale Oils (*Vis. at* 100°*F.*)		
Vis. Color		
100 No. 1½-2½	6.5	6.5
200 No. 2-3	8.75	8.75
300 No. 2-3	9.25	9.25
500 No. 2½-3½	10	10
750 No. 3-4	10.25	10.25
1200 No. 3-4	10.375	10.375
2000 No. 4	10.5	10.5

(Continued on next page)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown) bids reported in market leads.

Refinery Prices (Continued)

Prices in Effect	Jan. 3	Dec. 27
Red Oils:		
100 No. 5-6	6.5 (2)	6.5 (2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5	10.5-11.5

CHICAGO (From Mid-Continent p.l. crude.) Neutral oils *vis. at* 100° *F. to* 10 *p. p.*

Pale Oils Vis. Color		
60-85—No. 2	9.5 (1)	9.5 (1)
86-110—No. 2	10 (1)	10 (1)
150—No. 3	15.5 (1)	15.5 (1)
180—No. 3	16 (1)	16 (1)
200—No. 3	16 (1)	16 (1)
250—No. 3	17 (1)	17 (1)
Red Oils:		
180—No. 5	16 (1)	16 (1)
200—No. 5	16 (1)	16 (1)
250—No. 5	17 (1)	17 (1)
280—No. 5	18 (1)	18 (1)
300—No. 5	18.5 (1)	18.5 (1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower: 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined: (*Viscosity at* 210°)		
140	11.5 (1)	11.5 (1)
160	12.5 (1)	12.5 (1)
200	13.5 (1)	13.5 (1)
Bright stocks, 160 *vis. at* 210 *No. 8 color:*		
0 to 10 p.p.	24 (1)	24 (1)
15 to 25 p.p.	23.5 (1)	23.5 (1)
30 to 40 p.p.	21.5 (1)	21.5 (1)
E filtered Cyl. Stock	15.5 (1)	15.5 (1)

Note: To obtain prices delivered in Chicago, add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3		
Grade 26-70	4.75 (Sale)	4.75 (Sale)
FOB BRECKENRIDGE		
Grade 26-70	4.375 (Quote)	4.375 (Quote)
CALIFORNIA (FOB plants in Los Angeles basin)		
21 pound vapor pressure for blending	4.75- 5.375	4.75 - 5.375

Naphtha and Solvent

(*FOB Group* 3)		
Stoddard solvent	6.625	6.625
Cleaners' naphtha	7.125	7.125
V.M.&P. naphtha	7.1 - 7.125	7.1 - 7.125
Mineral spirits	6.1 - 6.125	6.1 - 6.125
Rubber solvent	7.1 - 7.125	7.1 - 7.125
Lacquer diluent	7.375- 8.125	7.375- 8.125
Benzol Diluent	8.375- 8.625	8.375- 8.625
WESTERN PENNA.		
Bradford-Warren District:		
Stoddard Solvent	7.5 (1)	7.5 (1)
Other Districts:		
Untreated naphtha	7 - 7.25	7 - 7.25
Stoddard solvent	7.25 - 7.75	7.25 - 7.75
OHIO (S. O. quotations for statewide delivery): V.M.&P. naphtha, D.C. naphtha, Varnolene & Sohio solvent	10	10
Rubber solvent	9	9

Wax

WESTERN PENNA. (Bbls. C.L.)		
White Crude Scale:		
122-124 A.m.p.	4.25 (2)	4.25 (2)
124-126 A.m.p.	4.25	4.25
OKLAHOMA (C.L. FOB Refinery)		
Semi-refined:		
128 AMP min., white, 50 kilo bags	No Price	No Price
132-134 AMP, bbls.	5.25 (1)	5.25 (1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars, 0.5c per lb. less.)		
Snow White	6.125- 7.25	6.125- 7.25
Lily White	5.375- 6.25	5.375- 6.25
Cream White	4.375- 5.5	4.375- 5.5
Light Amber	3.375- 4	3.375- 4
Amber	3.125- 3.75	3.125- 3.75
Red	3 - 3.5	3 - 3.5

Tank Wagon Prices

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes;** *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect Jan. 3, 1944 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. N. J.

Esso (*Regular Grade*)	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
*Atlantic City, N. J.	10.2	10.7	4.5	10
*Newark, N. J.	10.2	10.7	4.5	10
Annapolis, Md.	10.55	11.05	5.5	....
Baltimore, Md.	9.95	10.45	5.5	10.8
Cumberland, Md.	11.35	11.85	5.5	12.3
Washington, D. C.	10.2	10.7	4.5	11.3
Danville, Va.	11.65	12.15	6.5	12.55
Norfolk, Va.	10.45	10.95	6.5	12.3
Petersburg, Va.	10.75	11.25	6.5	13.3
Richmond, Va.	10.75	11.25	6.5	13.3
Roanoke, Va.	11.95	12.45	6.5	12.8
Charleston, W. Va.	12.25	12.75	6.5	13.6
Parkersburg, W. Va.	11.55	12.05	6.5	13.3
Wheeling, W. Va.	11.55	12.05	6.5	13.9
Charlotte, N. C.	12.1	12.6	7.5	11.6
Hickory, N. C.	12.65	13.15	7.5	12.6
Mt. Airy, N. C.	12.5	13.0	7.5	11.8
Raleigh, N. C.	11.85	12.35	7.5	12.6
Salisbury, N. C.	12.15	12.65	7.5	13.0
Charleston, S. C.	10.95	11.45	7.5	....
Columbia, S. C.	11.8	12.3	7.5	....
Spartanburg, S. C.	12.5	13.0	7.5	....

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2	No. 3
Atlantic City, N. J.	10	9	9
Newark	10	9	9
Annapolis, Md.	..	9.25	...
Baltimore	9.8	9	9
Washington, D. C.	10.3	9.4	9.4
Norfolk, Va.	10	8.8	8.8
Petersburg	10.3	9	...
Richmond	10.3	9	9
Charlotte, N. C.	10.6	10.4	...
Hickory, N. C.	....	10	...
Raleigh	11.6	10.1	...
Charleston, S. C.	....	9	...
Columbia	....	10	...
Spartanburg	....	10.8	...

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey. Discounts;

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey.

Naphthas—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals, 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

(N.B. Prices are Continental's "structural" prices. Prices do not reflect temporary reductions made to meet local competition.)

Notice

These prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline, 1/2c on kerosine; Ark. 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kans. 1/50c; La. 1/32c; Minn. 7/200c; Mis. 1/50c; Neb. 2/100c; Nev. gasoline 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/20c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Iowa 3/50c; Mich. 1/5c per gal.

CONT'L OIL

	Conoco Bronz-z-z (*Reg.*) †Tank Wagon	Demand (*3rd Grade*)	Gasoline Taxes	Kerosine T.W.
Denver, Col.	11	10	5.5	11
Grand Junc., Col.	12	11	5.5	12
Pueblo, Col.	10.5	9.5	5.5	10.5
Casper, Wyo.	11.5	10.5	5.5	12
Cheyenne, Wyo.	11	10	5.5	11.5
Billings, Mont.	12.5	11.5	6.5	12.5
Butte, Mont.	13.5	12.5	6.5	13.5
Great Falls, Mont.	12.5	11.5	6.5	12.5
Helena, Mont.	13	12	6.5	13
Salt Lake City, Utah	13.5	12.5	5.5	14.5
Boise, Ida.	14.1	13.1	6.5	16.5
Twin Falls, Ida.	15.6	14.6	6.5	17
Albuquerque, N. M.	10	9	*7	9.5
Roswell, N. M.	9.5	8.5	*7	9
Santa Fe, N. M.	10.5	9.5	*7.5	10
Ft. Smith, Ark.	9.5	9.25	*7	9.5
Texarkana, Ark.	9	8	*5.5	9
Muskogee, Okla.	9.5	8.5	7	8.5
Oklahoma City, Okla.	9.5	8.5	7	8.5
Tulsa, Okla.	9.5	8.5	7	8.5

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c, Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.; Okla. 5.5c state applies within city limits of Ft. Smith, Ark.

†To consumers & Dealers.

S. O. NEB.

(*Regular Grade*)	T.W. Dealer	Gasoline Taxes	Kerosine T.W.
Omaha	11.4	9.6	6.5	10.1
McCook	12.0	10.1	6.5	10.5
Norfolk	11.9	10.4	6.5	10.6
North Platte	12.3	10.6	6.5	11
Scottsbluff	12.9	10.2	6.5	10.5

Standard Gasoline (*Regular Grade*)
Flight Gasoline (*Third Grade*)

S. O. CAL.

	Standard Posted Net Tank Truck	Standard Posted Retail	Flight Posted Net Tank Truck	Flight Posted Retail	Gasoline Taxes
San Francisco, Cal.	10	14	9	12	4.5
Los Angeles, Cal.	9.5	13.5	8.5	11.5	4.5
Fresno, Cal.	11	15	10	13	4.5
Phoenix, Ariz.	12	16	10	13	6.5
Reno, Nev.	12	16	11	14	5.5
Portland, Ore.	10.5	14.5	9.5	12.5	6.5
Seattle, Wash.	10.5	14.5	9.5	12.5	6.5
Spokane, Wash.	12.5	16.5	11.5	14.5	6.5
Tacoma, Wash.	10.5	14.5	9.5	12.5	6.5

Std. Aviation 73

	Posted Net Tank Truck	Gasoline Taxes	Kerosine Tank Truck
San Francisco, Cal.	12.5	4.5	11.5
Los Angeles, Cal.	12	4.5	10
Fresno, Cal.	13.5	4.5	12.5
Phoenix, Ariz.	14.5	6.5	12.5
Reno, Nev.	14.5	5.5	13.5
Portland, Ore.	13	6.5	13.8
Seattle, Wash.	13	6.5	13.8
Spokane, Wash.	16	6.5	16.8
Tacoma, Wash.	13	6.5	13.8

Resale & Commercial: T.C. deliveries 0.25c per gal. off posted net tank truck.

Commercial: Retail deliveries, and/or tank truck deliveries of less than 40 gals., 4c per gal. above posted net tank truck price for Standard Aviation and Standard Gasoline, and 3c per gal. above posted net tank truck for Flight Gasoline, except single deliveries of less than 40 gals. to Marine trade only, which are billed at posted net tank truck price.

TEXAS CO.

	Gasoline—Dealer T.W. Fire-Chief (*Regular*)	Indian (*3rd Grade*)	Gasoline Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	7.5	6.5	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5	7.5	5.5
El Paso, Tex.	11	10.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8.5*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

(Continued on next page)

Tank Wagon Prices—Continued

S. O. IND.

Red Crown (*Regular Grade*)
Blue Crown (*Third Grade*)
Red Dealer Prices

	Crown Cons. T.W.	Red Crown	Blue Crown	Gaso-line Taxes	Kero-sine T.W.
Chicago, Ill.	11.6	9.6	9.1	4.5	10.6
Decatur, Ill.	11.6	9.6	8.7	4.5	10.3
Joliet, Ill.	11.9	10.3	9.2	4.5	10.4
Peoria, Ill.	11.7	9.9	9.7	4.5	10.4
Indianapolis, Ind.	11.6	10.1	9.6	5.5	10.1
Evansville, Ind.	11.4	9.9	8.6	5.5	9.9
South Bend, Ind.	12	10.5	10	5.5	10.5
Detroit, Mich.	11.4	9.9	9.4	4.5	10
Grand Rapids, Mich.	11.4	9.9	9.4	4.5	9.9
Saginaw, Mich.	11.4	9.9	9.4	4.5	9.9
Green Bay, Wis.	12.2	10.7	10.2	5.5	10.9
Milwaukee, Wis.	12.1	10.6	10.1	5.5	10.8
La Crosse, Wis.	11.9	10.4	9.9	5.5	10.6
Minneapolis - St. Paul	11.9	10.4	9.9	5.5	10.6
Duluth, Minn.	12.2	10.7	10.2	5.5	10.9
Mankato, Minn.	11.9	10.4	9.9	5.5	10.6
Des Moines, Ia.	11.4	9.9	9.4	*4.5	*10.1
Mason City, Ia.	11.7	10.2	9.7	4.5	*10.4
St. Louis, Mo.	11.0	9.5	9.3	*4.5	10.1
Kansas City, Mo.	11.0	9.5	8.6	*4.5	9.7
St. Joseph, Mo.	11.2	9.7	9.2	*4.5	9.9
Fargo, N. D.	12.9	11.4	10.9	5.5	11.6
Huron, S. D.	12.3	10.8	10.3	5.5	11
Wichita, Kans.	10.3	8.8	7.2	4.5	8.7

Stanavo Aviation 73 Octane

Chicago, Ill.	15.7	4.5
Milwaukee, Wis.	15.9	5.5
Minneapolis, Minn.	15.7	5.5
St. Louis, Mo.	15.2	*4.5
Kansas City, Mo.	14.8	*4.5
Fargo, N. D.	16.7	5.5
Huron, S. D.	16.1	5.5

	Oleum Spirits	V.M.&P. Naphtha	Stani-sol	*Taxes
(Prices are base prices before discounts)				
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	3.5
St. Louis, Mo.	13.7	14.7	13.2	3.5
Milwaukee	14.4	15.4	14.9	5.5
Minnep'ls	14.2	15.2	13.5	5.5

Fuel Oils T.W.
Chicago

	Standard Heater Oil
1-99 gals.	9.3
100-149 gals.	8.3
150 gals. & over	7.8

	Stanolex Furnace Oil
1-99 gals.	8.8
100-149 gals.	7.8
150-399 gals.	7.8
400 gals. & over	7.3

	Stanolex Fuel Oil A
1-99 gals.	8.3
100-399 gals.	7.3
400-749 gals.	6.3
750 gals. & over	5.55

	Stanolex Bunker C Fuel Oil
1-399 gals.	6.8
400-999 gals.	5.8
1000 gals. & over	4.8

Other Points Indianapolis	Stanolex Furnace Oil
1-99 gals.	9.0
100 gals. & over	8.0
Detroit	
1-99 gals.	8.7
100 gals. & over	7.7
Milwaukee	
1-99 gals.	9.0
100 gals. & over	8.0
Minneapolis	
1-99 gals.	9.1
100 gals. & over	8.1
St. Louis	
1-99 gals.	8.1
100 gals. & over	7.1
Kansas City	
1-99 gals.	8.1
100 gals. & over	7.1

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, Ic. Iowa kerosine prices are ex 3c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

State sales, occupation, consumer and use taxes to be added when applicable.

HUMBLE OIL

Humble Motor Fuel (*Regular Grade*)

	Thriftane Humble *Tank Wagon	Thriftane Re-tail	(*Third Grade*) Thriftane *Tank Wagon	Thriftane Re-tail	Gaso-line Taxes
Dallas, Tex.	7.5	10.5	6.5	10.5	5.5
Ft. Worth, Tex.	6.5	9.5	6	7.5	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Ant., Tex.	8.5	12.5	7.5	10.5	5.5

	Kerosine *Tank Wagon	Kerosine Retail
Dallas, Tex.	7	10
Ft. Worth, Tex.	7	11
Houston, Tex.	8	11
San Antonio, Tex.	7	10

	73 Oct. Aviation Gasoline Tank Car
FOB Baytown, Tex.	8.5

*To all classes of dealers & consumers.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher. Cleveland Division assumed the state-wide fuel oil tank wagon prices on Nos. 1, 2 and 3 fuel oil, effective May 10. However the price of 7.55c per gallon and No. 4 fuel oil (full compartment hose dumps only) will remain as heretofore, in Cleveland Division.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

S. O. OHIO

*Sohio X-70 Gasoline (*Regular Grade*)

	Con-sumer T.W.	**Re-sel-lers	‡S.S.	Gaso-line Taxes	†Kero-sine T.W.
Ohio, Statewide	12	10	13.5	5.5	9.3
Akron	12	9.5	12.5	5.5	9.3
Cincinnati	12	9.5	12.5	5.5	9.3
Cleveland	12	9.5	12.5	5.5	9.3
Columbus	12	9.5	12.5	5.5	9.3
Dayton	12	9.5	12.5	5.5	9.3
Marietta	12	9.5	12.5	5.5	9.3
Portsmouth	12	9.5	12.5	5.5	9.3
Toledo	12	9.5	12.5	5.5	9.3
Youngstown	12	9.5	12.5	5.5	9.3

Aviation Gasoline—Statewide

	Consumer T.W.	Gasoline Taxes
Sohio aviation grade 65 octane, Spec. AN-VV-F-756	14.5	5.5
Esso Ethyl Aviation 73 Oct.	15.5	5.5
Esso Ethyl Aviation 80 Oct.	16.5	5.5
Esso Ethyl Aviation 87 Oct.	17.5	5.5
Esso Ethyl Aviation 91 Oct.	17.5	5.5
Esso Ethyl Aviation 100 Oct.	25.5	5.5

	†Naphtha—T.W. Statewide	Lucas County
S. R. Solvent	13.5	13.5
D. C. Naphtha	14.5	14.25
V.M.&P. Naphtha	14.5	14.25
Varnolene	14.5	14.25
Sohio Solvent	14.5	14.25

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.3	8.3	7.8	7.55*

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

†Kerosine prices are ex 1c state tax. Naphtha prices are ex 1.5c federal & 4c state tax.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

*For Cleveland area only.

Canada

PRICES OF IMPERIAL OIL, LTD.

Per Imperial Gallon, which is 1.2 U. S. Gallons

IMPERIAL OIL

3-Star Imperial Gasoline (*Regular Grade*)

	†Gasoline T.W.	*Gasoline Taxes	†Kero-sine T.W.
Hamilton, Ont.	17.5	11	18
Toronto, Ont.	17.5	11	18
Brandon, Man.	21	10	23
Winnipeg, Man.	20.5	10	22.5
Regina, Sask.	18	10	20
Saskatoon, Sask.	20.8	10	22.8
Edmonton, Alta.	18.9	10	20.9
Calgary, Alta.	16	10	18
Vancouver, B. C.	15	10	24
Montreal, Que.	17	11	17.5
St. John, N. B.	16.5	13	19
Halifax, N. S.	16.5	13	19

*Includes 3c Federal, and Provincial taxes.
†To divided & undivided dealers.

ATLANTIC REFINING

Atlantic White Flash (*Regular Grade*)

	Commercial T.W.	Dealer T.W.	Gaso-line Taxes	Kero-sine T.W.
Philadelphia, Pa.	10.2	10.7	5.5	12.25
Pittsburgh	10.7	11.2	5.5	12.6
Allentown	10.7	11.2	5.5	12.6
Erie	10.7	11.2	5.5	12.6
Scranton	10.7	11.2	5.5	12.6
Altoona	10.7	11.2	5.5	12.6
Emporium	10.7	11.2	5.5	12.6
Indiana	10.7	11.2	5.5	12.6
Uniontown	10.7	11.2	5.5	12.6
Harrisburg	10.7	11.2	5.5	12.6
Williamsport	10.7	11.2	5.5	12.6
Dover, Del.	....	11.2	5.5	12.6
Wilmington, Del.	....	10.7	5.5	12.1
Boston, Mass.	....	10.9	5.5	....
Springfield, Mass.	....	11.8	4.5	....
Worcester, Mass.	....	11.5	4.5	....
Fall River, Mass.	....	11	4.5	....
Hartford, Conn.	....	11.6	4.5	....
New Haven, Conn.	....	11	4.5	....
Providence, R. I.	....	11	4.5	....
Atlantic City, N. J.	....	10.7	4.5	10
Camden, N. J.	....	10.7	4.5	10
Trenton, N. J.	....	10.7	4.5	10
Annapolis, Md.	....	11.05	5.5	10.8
Baltimore, Md.	....	10.45	5.5	9.8
Hagerstown, Md.	....	11.55	5.5	10.3
Richmond, Va.	....	11.25	6.5	12.3
Wilmington, N. C.	11.55	7.5	11.9	....
Brunswick, Ga.	....	10.4	7.5	11.1
Jacksonville, Fla.	....	10.4	8.5	12.1

	Mineral Spirits T.W.†	V.M.&P. T.W.†
Philadelphia, Pa.	11	12.5
Lancaster, Pa.	12	13.5
Pittsburgh, Pa.	12.5	13.5

Fuel Oils—T.W.

	1	2	3	5	6
Phila., Pa.	10.1	9	9	5.76	5.04*
Allentown, Pa.	10.6	9.3	9.3	....	....
Wilmington, Del.	10.1	9	9	....	....
Springfield, Mass.	10.2	9.4	9.4	....	....
Worcester, Mass.	10.2	9.3	9.3	....	....
Hartford, Conn.	10.5	9	9	....	....

‡Does not include 1c Georgia kerosine tax.
†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w., except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delaware, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

*Residual fuel 13.0-15.9 gravity effective 10/17/43.

S. O. KY.

Crown Gasoline (*Regular*)
Standard (*Third Grade*)

	†Net Crown	Dealer Standard	Gaso-line Taxes	Kero-sine T.W.
Covington, Ky.	9.5	...	6.5	9.3
Lexington, Ky.	10.5	8.5	6.5	9.3
Louisville, Ky.	10	...	6.5	8.8
Paducah, Ky.	10	8	6.6	8.8
Jackson, Miss.	10	9	7.5	*9
Vicksburg, Miss.	9.5	...	7.5	*8.5
Birmingham, Ala.	10	9	*8.5	9
Mobile, Ala.	9	...	*9.5	8.5
Montgomery, Ala.	10	9	*9.5	10
Atlanta, Ga.	11.4	...	7.5	*12.1
Augusta, Ga.	11.4	...	7.5	*11.5
Macon, Ga.	11.4	...	7.5	12.1
Savannah, Ga.	10.4	...	7.5	11.1
Jacksonville, Fla.	10.4	...	8.5	10.1
Miami, Fla.	10.4	...	8.5	10.1
Pensacola, Fla.	9	8	*9.5	8
Tampa, Fla.	10.4	...	8.5	10.1

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city; Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, not included in above prices.

†Consumer t.w. prices are same as net dealer prices.

S. O. LA.

Esso Gasoline (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gaso-line Taxes	Kero-sine T.W.
New Orleans, La.	8.75	9.25	8.5	*9
Baton Rouge, La.	8.75	9.25	8.5	*9.5
Alexandria, La.	8.75	9.25	8.5	*9.5
Lafayette, La.	9	9.5	8.5	*9
Lake Charles, La.	9	9.5	8.5	*11
Shreveport, La.	8.5	9	8.5	*8
Knoxville, Tenn.	9.5	10	8.5	12.5
Memphis, Tenn.	8.90	9.40	8.5	10.5
Chattanooga, Tenn.	10.5	11	8.5	11
Nashville, Tenn.	10.5	11	8.5	10
Bristol, Tenn.	10.95	11.45	8.5	13.1
Little, Rock, Ark.	9.5	10	8	10

*Louisiana kerosine prices are ex 1c state tax.

Discounts:

Esso Gasoline—To undivided dealers, 0.5c off dealer t.w.

(Continued on next page)

Seaboard Export Coastwise Prices

Atlantic Coast (Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices in Effect Jan. 3

MOTOR GASOLINE

District:	72 Oct. (ASTM)	68-70 Oct. (ASTM)	KEROSINE and/or NO. 1 FUEL
N. Y. Harb.	9.2 – 9.4	9.2 (1)	7.1
N. Y. Harb., barges	9.1 – 9.3	9.1 (1)	7
Albany	9.3 – 9.5	....	7.3
Philadelphia	9.2	....	7.2
Baltimore	8.95	8.85 (1)	7.2
Norfolk	8.7 – 8.95	8.5 (1)	7.1
Wilmington, N. C.	8.7 – 8.75	8.5 (1)	7.05
Charleston	8.7 – 8.8	8.1 (1)	7.2
Savannah	8.25 – 8.4	....	7.05
Jacksonville	8.27 – 8.4	....	7.05 (2)
Miami	8.27 (1)	....	7.05 (2)
Tampa	8.27 – 8.4	8.275 (1)	7.05
Pensacola	7 – 7.2 (1)	....	4.8 (1)
Mobile	7 – 7.2	....	4.75-5.05 (2)
New Orleans	6.125– 6.75	....	4.25 – 4.75
Portland	9.5 – 9.65	....	7.3
Boston	9.4 – 9.7	9.7 (1)	7.2
Providence	9.4 – 9.7	....	7.2

FUEL OILS

No. 2	No. 3	No. 5	No. 6
6.7	6.7	$1.95–$2.01 (a)	$1.65 –$2.07
6.6	6.6	....	....
6.8	6.8 (2)	....	$1.85–$2.27 (1)
6.7	6.7	$1.98	$1.65 –$2.07
6.7	6.7	....	$1.65 –$2.07
6.7	6.7 (1)	....	$1.65–$2.07 (2)
6.7	....	....	....
6.7 (2)	....	....	$1.60–$2.02 (2)
....	....	....	$1.60–$2.02 (1)
6.25	....	....	$1.60–$2.02 (1)
....	....	....	....
6.25 (2)	....	....	$1.50–$1.92 (2)
....	....	....	....
....	....	....	....
3.75 (2)	....	$1.27 (1)	$0.85–$1.27 (2)
6.8	6.8 (2)	....	$1.65–$2.07 (1)
6.7	6.7 (2)	$1.95–$2.07 (1)	$1.65 –$2.07
6.7	6.7 (2)	$1.90 (1)	$1.65 –$2.07

(a) This price is for a straight-run low pour test No. 5 fuel.

Pacific Export *In Ship's Bunkers, or deep tank lots:*

Prices in Effect	Jan. 3	Dec. 27
Diesel Fuel, Pac. Spec. 200	$1.40 –$1.45	$1.40 –$1.45
Grade C fuel, Pac. Spec. 400	$1.10	$1.10

Tank Wagon Prices (Continued)

SOCONY VACUUM

	Socony Mobilgas (Regular Grade) Com. Cons. T.W.	Indiv. Dlr. T.W.	Gasoline Taxes
New York City			
Manhattan & Bronx	10.1	10.6	*5.5
Kings & Queens	10.1	10.6	*5.5
Richmond	9.7	10.2	*5.5
Albany, N. Y.	9.9	10.4	5.5
Binghamton, N. Y.	11	11.5	5.5
Buffalo	10.2	10.7	5.5
Jamestown, N. Y.	10.4	10.9	5.5
Mt. Vernon, N. Y.	10.1	10.6	5.5
Plattsburg, N. Y.	11	11.5	5.5
Rochester, N. Y.	10.8	11.3	5.5
Syracuse, N. Y.	10.5	11	4.5
Bridgeport, Conn.	10	10.5	4.5
Danbury, Conn.	10.5	11	4.5
Hartford, Conn.	10.6	11.1	4.5
New Haven, Conn.	10	10.5	4.5
Bangor, Me.	10.7	11.2	5.5
Portland, Me.	10.3	10.8	5.5
Boston, Mass.	9.9	10.4	4.5
Concord, N. H.	11.4	11.9	5.5
Lancaster, N. H.	12	12.5	5.5
Manchester, N. H.	11.3	11.8	5.5
Providence, R. I.	10	10.5	4.5
Burlington, Vt.	10.9	11.4	5.5
Rutland, Vt.	11	11.5	5.5

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	12.4	13.6
New York City	11	12
Rochester, N. Y.	13.2	14.4
Syracuse, N. Y.	14	....
Boston, Mass.	12	13
Bridgeport, Conn.	†16.3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	Kerosine T.W.	Mobilfuel Diesel T.C.	Mobilfuel Diesel T.W.	Mobilheat Fuel Yard	Mobilheat Fuel T.W.
New York:						
Manhat'n & Bronx	7.5	10.3	...	9.3	7.1	9
Kings & Queens	7.5	10.3	...	9.3	7.1	9
Richmond	7.5	10.3	...	....	7.1	9.0
Albany	7.5	9.8	7	9.3	7	9
Binghamton	8.9	11.2	...	10.7	8.4	10.2
Buffalo	8.6	10.9	8	10.3	8.2	10
Jamestown	8.7	11	...	10.6	8.3	10
Mt. Vernon	7.6	10.3	...	9.4	7.2	9
Plattsburg	8.1	10.4	...	9.9	7.6	9.4
Rochester	8.7	11	7.9	10.2	7.9	9.7
Syracuse	8.5	10.8	7.8	10.1	7.8	9.6
Conn.:						
Bridgeport	7.8	10.3	...	....	7.2	8.8
Danbury	8.2	10.8	...	....	7.5	8.8
Hartford	8.0	10.5	...	9.5	7.2	9
New Haven	7.8	10.3	...	9.3	7	8.9
Maine:						
Bangor	7.9	10.2	7.4	9.7	7.4	9.1
Portland	7.5	10.2	7	9.3	7	9
Mass.:						
Boston	7.8	10.6	6.9	9.2	7.1	9
N. H.:						
Concord	8.4	10.7	...	....	8.2	10
Lancaster	9.5	11.8	...	....	9.2	11
Manchester	8.5	11.1	...	....	7.9	9.7
R. I.:						
Providence	7.6	9.9	6.9	9.2	7.1	8.9
Vermont:						
Burlington	8.1	10.4	7.5	9.8	7.5	9.2
Rutland	8.3	10.6	...	10	7.7	9.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).

†In steel barrels.

Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
N. Y. Harbor	$1.65–$2.07 (a)	$2.78	6.7–6.8 (2)	6.8 (2)
Albany	$1.85 (1)	$2.98 (1)	7 (1)	6.7
Philadelphia	$1.65–$2.07	$2.78	....	....
Baltimore	$1.65–$1.77 (a)	$2.78	6.7 (1)	6.7 (1)
Norfolk	$1.65–$2.07	$2.78	6.7 (1)	6.7 (1)
Charleston	$1.60–$2.02	$2.78 (2)	6.7 (1)	6.7 (1)
Savannah	$1.60–$1.77 (1)	$2.62 (1)	....	....
Jacksonville	$1.60–$2.02 (2)	$2.62 (2)	....	....
Tampa	$1.50–$1.92	$2.62 (2)	....	....
New Orleans	$0.97–$1.09	$1.65 (1)	4 (1)	....
Portland	$1.65–$1.77 (1)	$2.86 (1)	7 (1)	6.9 (1)
Boston	$1.65–$1.77	$2.78	6.7 (2)	6.8 (2)
Providence	$1.65–$2.07	$2.78 (2)	6.9 (1)	6.8 (1)

Residual fuel prices generally vary with A.P.I. specifications from range low for 9.9 & below degrees to range high for 25.0 & above.

(a) This price correct on and since Nov. 24.

Gulf Coast

Prices in Effect Jan. 3

MOTOR GASOLINE	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	New Orleans & Lower Mississippi to Baton Rouge Barge	Texas Gulf Coast South of New Orleans Tank Cars	Texas Gulf Coast South of New Orleans Barges	CARGOES Domestic & Export From all Gulf Ports
Leaded (oct by ASTM)					
76 oct.	6.75	6.5 – 6.75	6.75	6.75	6.75
72 oct.	6.125	5.75	5.75	5.75	5.75
63-65 oct.	....	....	....	....	....
Unleaded 70 oct.	....	....	....	....	5.75
67-68 oct.	....	....	....	....	5.5
65 oct.	....	....	....	....	5.25
60 oct.	....	....	....	....	5
KEROSINE & LIGHT FUELS					
41-43 w.w. kero.	4.125–4.25	4.125	4.125–4.25	4.125	4.125
42-44 w.w. kero.	....	....	4.125	4.125	4.125
No. 2 fuel oil	3.75	3.75	3.75 – 4	3.75	3.75
DIESEL & GAS OILS					
(In diesel index No.)					
Below 43 di.	....	....	....	....	....
43-47 di.	....	....	....	....	4
48-52 di.	4	4	4	4	4
53-57 di.	4.125	4.125	4.125	4.125	4.125
58 and above	4.25	4.25	4.25	....	4.25

HEAVY FUELS & BUNKER OILS In Cargoes (At all Gulf Ports) Heavy Diesels	In Ship's Bunkers (Ex lighterage)
Below 28 API Grav.	$1.35
28 & above API Grav.	$1.65
Bunker C Oil	$0.85–$1.27

Above products in Truck Transports of 2,400 gal. and over ½c above Tank Car Prices.

NOTE—Prices for heavy fuels vary within the range given above according to gravity from 9.9 B grav. and below to 25 B and above.

Mid-Continent Lubes

(At Gulf; in packages, FAS.; in bulk, FOB terminals)

Prices in Effect Jan. 3

	Steel Drums	Bulk
200 Vis. D 210 brt. stock	35 (1)	28.8 (1)
150 vis. D 210 brt. stock 0-10 p.p.	31 (1)	24.8 (1)
10-25 p.p.	....	....
100 vis. D 210 brt. stock 0-10 p.p.	....	....
10-25 p.p.	....	....
200 vis. No. 3 col. neutral: 0-10 p.p.	....	....

Wax

(Melting points are AMP, 3° higher than EMP. Prices are FOB refinery and do not include bag, freight or export differentials).

Prices In Effect Jan. 3

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25(1)	....	4.25(1)
122-4 White.	....	4.25(2)	4.25(2)
124-6 White.	4.25(1)	4.25	4.25
Fully Refined:			
123-5	5.2(1)	5.2(2)	5.2(1)
125-7	5.2(1)	5.2(2)	5.2(1)
128-30	5.6(1)	5.6	5.6(1)
130-32	5.85(1)	5.85(2)	5.85(1)
133-5	6.15(1)	6.15	6.15(1)
135-7	6.4(1)	6.4(1)	6.4(1)

Naphtha

Prices In Effect Jan. 3

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia dist.	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

WAR-OIL EQUIPMENT EXCHANGE

If You Can't Use It, Sell It or Scrap It!

For Sale

PIPE FOR SALE

24000 feet 4 inch Black Steel Pipe, threaded and coupled with thread protectors, standard weight, used once, condition like new. Priced at 35 cents per foot, F.O.B. cars Erlanger, Kentucky.

Gallagher, Kraemer & Watson
629 Olin Ave., Madison, Wis.

Heil truck tank with four 250 gallon compartments complete with 2" lines and valves. Full skirts with enclosed barrel and can racks. Recently removed from D-40 International with 175" wheel base.

R. E. Stueber,
c/o The Texas Company, Little Rock, Ark.

Situations Open

• • • • WANTED • • • •

Major oil company with continent-wide operations and research seeks graduate technical men of the following qualifications:

MECHANICAL ENGINEERS—with petroleum refinery or similar experience. Should be familiar with refinery design, estimating, construction, mechanical equipment, engineering materials, and utilities systems. Process knowledge desired although not essential.

CHEMISTS AND CHEMICAL ENGINEERS interested in research, design, or plant operation. Should have training and experience in refinery or other industrial organizations.

Work not of a temporary nature. In reply state experience, education, age, marital status, draft classification and salary expected, include small snapshot (not returnable). Replies strictly confidential. Applicants now employed at highest skill in war industries not solicited. **Box No. 249, National Petroleum News, Cleveland, Ohio.**

Wanted to Buy

WANTED TO BUY: Grease kettles pressure and mixing. State type, capacity, condition and where located. Box No. 311.

Position Wanted

Now is the time to organize your service station department for post-war business. I have spent twenty years in retail merchandising. 17 years with one major in charge of the field activity of 1400 units. An interview will convince you that I can make your stations click.

O. L. Baldwin,
Biloxi, Miss.

Situations Open

Experienced 3-C Anti-Knock Octane Testing Operator wanted, or capable motor method operator interested in learning newest Anti-Knock methods. Also some other lab positions open. Splendid opportunity get into essential war work. Box No. 319.

DESIGNING ENGINEER WANTED

Capable of designing gasoline and oil truck tank carriers. Excellent opportunity for man with right qualifications and experience. Shop located in South.

Box No. 314

NEW YORK REPRESENTATIVE

Prominent manufacturer truck tanks, transport tanks, and marketing equipment, seeks high-class man for New York City, possibly other territories. Good connection for right man. Previous experience and engineering back ground preferred. Replies confidential. Present sales personnel advised of this advertisement.

Box No. 312

• • • WANTED • • •

MECHANICAL OR CHEMICAL ENGINEERS

Major oil company with nation-wide operations seeks *Mechanical or Chemical Engineers,* preferably college graduates, with experience in lubricating oils and their application to industry. Sales experience in this field will be helpful but not essential.

Such men can expect:

1. **A good future in work covering lubrication problems in industrial plants now primarily working on war equipment.**
2. **To participate in a training course presented by the employer.**
3. **To receive a good starting salary.**
4. **To have employment which will not be of a temporary nature.**

In reply state experience, education, age, marital status, draft classification and salary expected and include small snapshot (not returnable). Replies strictly confidential. If employed in essential war work, availability certificate required. If already working at your highest skill, do not apply. Box 315.

• • • WANTED • • •

Experienced Grease Man

A major oil company with nation-wide operations seeks man who has experience and thorough knowledge in the development and manufacture of greases for Industrial, Marine and Automotive applications.

In replying state experience, education, age, marital status, draft classification and salary expected; also include small snapshot (not returnable). Replies strictly confidential. If employed in essential war work, availability certificate required. If already working at your highest skill, do not apply. Box 316.

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ABOUT OIL PEOPLE

Roland E. Skelton, formerly vice-president of the Crown Oil Corp., Harrison, N. J., has become associated with Dornoil Products Co., Newark, N. J., Cities Service distributors. Before forming the Crown Oil Corp. in 1934, Mr. Skelton had charge of Vacuum Oil Corp.'s operations in western New York.

* * *

Mr. Allan

P. E. Allan, general sales manager of the Associated Division of Tide Water Associated Oil Co., has been appointed a vice-president of the company. Announcement of the appointment was made by the company's board of directors. Mr. Allan joined Tide Water in 1915 and by 1920 was assistant sales agent at Portland, Ore. During the intervening years he served in various capacities in the lubrication and refined oil divisions of the general office, subsequently becoming district sales manager in San Francisco and domestic sales manager of the Associated Division. In his current position of general sales manager, Mr. Allan has taken a leading part in petroleum industry activities in the Western section of the country.

* * *

The Carter Oil Co. has established headquarters of the northern division at Billings, Mont., with **R. E. Damp** as division superintendent and **O. A. Seager,** former division geologist in the northern division, his assistant. The division comprises Montana, Wyoming, Colorado and North and South Dakota.

Other changes include **Nelson Y. Ruth,** northern division landman, who will be in charge of all exploration activities in the northern division; **Don Blackstone,** former district geologist, northern division geologist. **T. J. Landry,** in charge of sales and refining, will continue to maintain headquarters at Cut Bank, Mont. **H. R. Shannon,** formerly district superintendent in Illinois, becomes district superintendent in charge of Wyoming operations.

* * *

M. A. Wright, senior engineer in the production engineering department of Carter Oil Co., Tulsa, has been made assistant to **J. R. McWilliams,** manager of the production department. Mr. Wright came to Tulsa several months ago from Shreveport where he was division engineer for the southern division of Carter.

Anticipating postwar developments in overseas operations, The Texas Co. has consolidated its export sales department and producing department—foreign, into a unit known as foreign operations, it has been announced by **C. E. Olmsted,** Texaco vice president in charge of these operations. An executive division has been created with **W. F. Moore,** former manager of the Purchasing Department, and **W. H. Borie,** former general manager of the export sales department, as assistants to the vice president in charge of administration and sales respectively. **Harris T. Dodge,** former assistant general manager of export sales department, becomes general manager of foreign sales. **F. C. Sealey** retains his post as manager of foreign production.

W. I. Moody has been named assistant to the management in the new executive division. **A. J. Singleton,** managing director of The Texas Oil Co., Ltd. (England), and **O. B. Small,** former superintendent of the export sales department's Caribbean division, have been named assistant general managers of the sales department.

Changes in the management of Texaco's purchasing department also have been announced. **Greer W. Orton,** former assistant to the manager, succeeds **W. F. Moore** as manager. **R. S. Hatch** is now assistant manager and **R. M. Morrison** becomes general purchasing agent.

En route to London on business, James W. Platt, general manager of the Shell-Mex Oil Co., Buenos Aires, arrives in Miami by Pan American Clipper. He told reporters business in the Argentine is excellent with prospects good for a big postwar expansion

Thomas Midgley, Jr., vice-president of Ethyl Corp. and internationally known for his discovery of tetraethyl lead, became president of the American Chemical Society on Jan. 1, 1944, succeeding **Per K. Frolich,** director of the Chemical Division, Esso Laboratories, Standard Oil Development Co., Elizabeth, N. J. **Carl Shipp Marvel,** professor of organic chemistry in the University of Illinois, has been elected president of the Society for 1945 and took office as president-elect Jan. 1.

Robert E. Wilson, New York, president of the Pan American Petroleum & Transport Co., is a newly elected director of the Society.

* * *

The Chicago Oil Men's Club collected $150 at their annual Christmas party Dec. 21 for a charity to be selected by the board of directors. The 125 oil men present saw **J. Glen Phinney** of Cities Service Oil Co. receive a $50 war bond for his efforts as retiring president.

* * *

Lynn Wimmer, who preceded **Earl Lamm** as head of editorial operations in NPN's Chicago office, is now a Technician 5th Grade and stationed in England with the 188th general hospital. Lynn is in the morale unit as editor of the hospital's newspaper. He volunteered for duty in December of 1942.

* * *

Capt. Elmo K. Ballard, Jr., son of **Elmo K. Ballard** of Standard Oil Co. of Ohio's refined oil department, was one of the chief attractions at the Christmas open house held in the offices of George N. Olson in Chicago, as he told of some of his experiences in Africa. Capt. Ballard has just returned from 14 months overseas.

* * *

Phil H. Bohart, assistant to the vice-president of Gulf Oil Corp. and Gulf Pipeline Co., was elected president of Tulsa's Chamber of Commerce for 1944.

* * *

Among the directors recently elected to the board of Tulsa Chamber of Commerce are **H. N. Greis,** president of Deep Rock Oil Co., **Charles Klein,** treasurer of Mid-Continent Petroleum Corp., **R. B. Roark,** vice president of Shell Oil Corp., and **G. H. Westby,** president of Seismograph Service Co., Inc. They will serve for three years beginning January 1.

* * *

M. L. Freese, president of Associated Refineries, Inc., and vice president of Bell Oil & Gas Co., stepped into a hole and broke his ankle recently while looking over the new 100-octane aviation gasoline plant being built for Associated at Duncan, Okla.

NEW CITATION FOR BROWNIES!

ARMY E NAVY

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We wouldn't be human if we didn't feel like bragging about the records all of us made in 1943 but we're doing our bragging in a spirit of humble gratitude.

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And it was the year we stopped worrying about what's going to happen after the war. With men and women like you on our side, there's nothing to worry about.

Is it any wonder we are proud...and very grateful?

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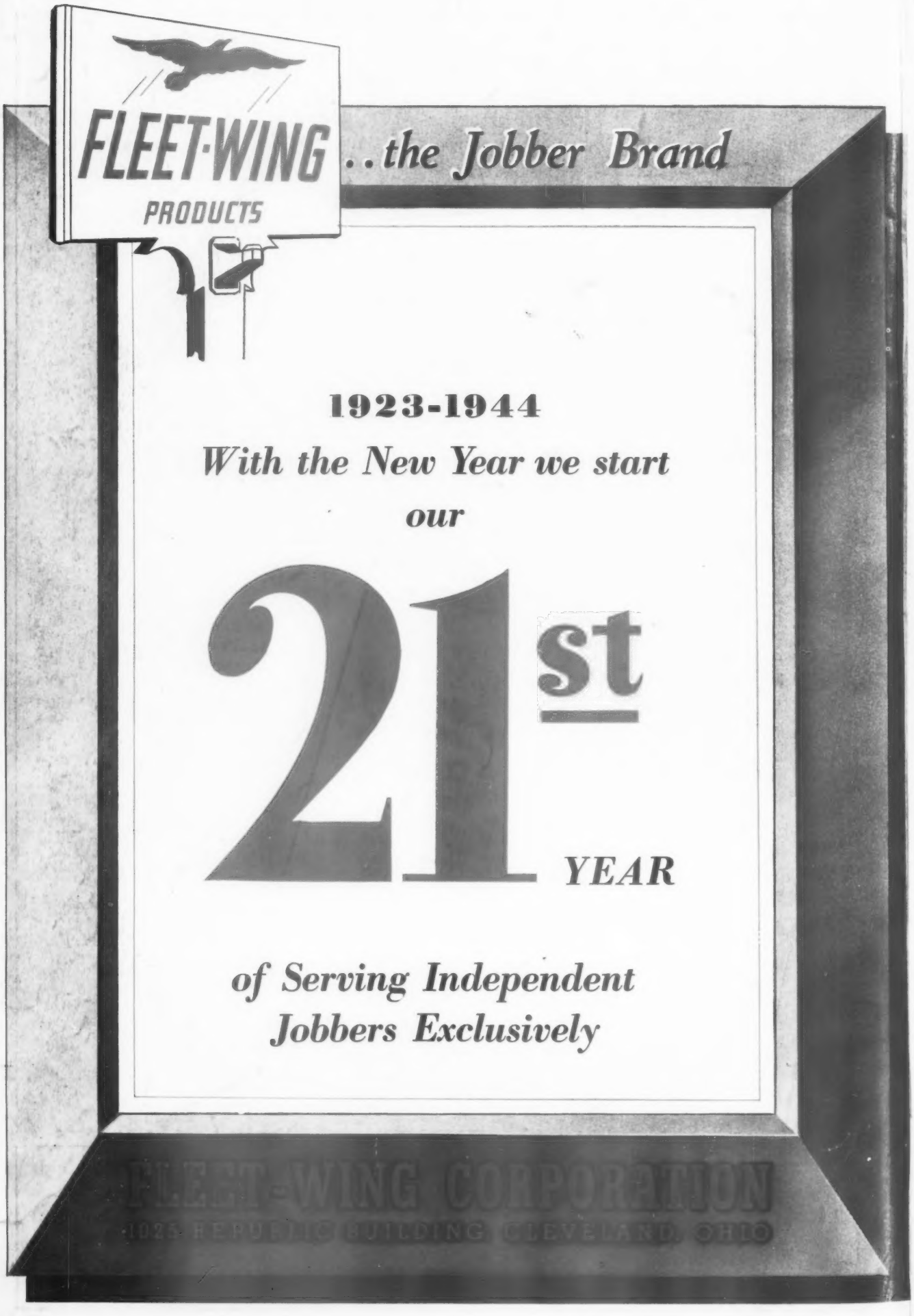
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TECHNOLOGY DEPT.

NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to

REFINERY MANAGEMENT *and* PETROLEUM CHEMICAL TECHNOLOGY

Section Two **January 5, 1944**

THE CREW MAKES READY TO TAKE OVER the new fluid catalytic cracking plant at the Baltimore refinery of Standard Oil Co. of New Jersey. Herman Gunter, technical assistant of the aviation gasoline plant, (right) explains an operating detail. These men were specially selected and trained and on their new jobs will be in charge of equipment costing several millions, part of it housed in a steel structure higher than a 20-story building. A small number of trained operators is required for the new refining units because of the extensive use of registering and recording and automatic control instruments.

Automatic Control Insures Accurate Functioning of New Plants
(Papers from Symposium of Amer. Society of Mechanical Engineers) *See pgs. R-3—R-10*

Liquefied Petroleum Gas Industry Expands to Serve War Needs
By G. G. Oberfell *See pg. R-11*

The Use of Alloys to Combat Corrosion from High Sulfur Crudes
By B. B. Morton *See pg. R-20*

Wide Variety of Compounds Patented as Diesel Fuel Additives
See pg. R-30

Modern Refining Technique Creates Uses for Welded Equipment
By Russell J. Love *See pg. R-37*

George Granger Brown

He Sold the Virtues Of Natural Gasoline To Men Who Made It

NEW president of the American Institute of Chemical Engineers is George Granger Brown, chairman of the Department of Chemical and Metallurgical Engineering of the University of Michigan. He was elected at the annual meeting of the institute at Pittsburgh Nov. 14-16. His research work several years ago for the Natural Gasoline Assn. of America established a scientific basis for the use of natural gasoline to improve the volatility and other characteristics of motor fuels. For these investigations he was given the Hanlon award of the association in 1940. In 1939 he was given the William H. Walker award of the chemical engineers' institute in recognition of his scientific papers.

Dr. Brown received his B.S. degree from New York University in 1917 and later scientific degrees from this institution and the University of Michigan. He first became a member of the teaching staff at Michigan in 1920. His investigations in the natural gasoline field have been continued and from time to time are reported to the oil industry.

REFINERY MANAGEMENT *and*
PETROLEUM CHEMICAL TECHNOLOGY

Jan. 5, 1944
Volume 36
Number 1

A MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS *incorporating International Petroleum Technology*

Small Crews and Automatic Controls Run New Refineries

The new aviation gasoline and rubber chemicals plants being completed and put into operation over the country are marvels of instrumentation. Their control systems are delicately tuned to register temperatures, pressures, flow levels, reaction timing and other conditions and automatically to act in response to the slightest irregularities. Through this means an exactness in operations is secured and reflected in quality of product, which would not be possible with manual operations. At the same time the number of trained personnel required to operate the plants is considerably reduced.

The general dependence on automatic control, together with the fact that some of the new processes such as hydrogen fluoride alkylation have brought new problems in instrument design and maintenance, have made necessary special training for the operating personnel. The oil companies have conducted schools for operating crews and instrument men. In some cases women are being successfully used in this work.

The growing importance of instrument control in modern plant operations prompted the American Society of Mechanical Engineers to conduct a symposium on Wartime Problems of Industrial Instrument Departments Nov. 30, in New York, in connection with the annual meeting of the Society. Two papers were presented by authorities in the design and operation of petroleum refineries. They discuss design and installation features to minimize instrument maintenance, special problems caused by the new processes, the effect of wartime restrictions on materials and design of control instruments, and they give experiences with this equipment in putting new process units into operation. These papers and two others discussing the training of plant personnel in instrument maintenance are published in the following pages.

Minimizing Instrument Maintenance In Designing Aviation Gasoline Plants*

*By Donald J. Bergman** and G. G. Gallagher***

741.4

SUCCESSFUL OPERATION of the various processes used for production of the components of modern aviation gasoline is highly dependent in every case upon the accuracy and reliability of indicating and recording instruments and automatic control actuated from such equipment.

The following comments are based largely upon the engineering developed for instrumentation of a number of projects in the aviation gasoline program in this country.

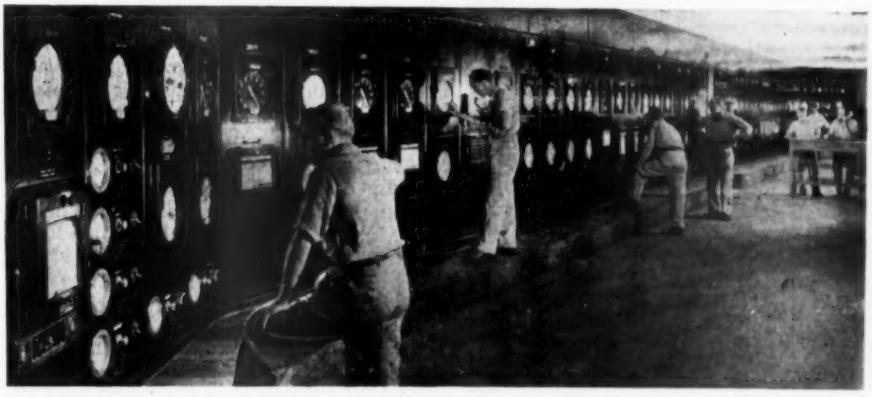
Qualifications of Personnel

In order to minimize the amount of labor spent in maintaining instruments and controls, the instrument man must, of course, know the details of the instruments on which he is working. Furthermore, he must know certain phases of the fundamentals and details of the various new processes on which the instruments are installed in order to appreciate the problems of an instrument and enable him to analyze the source of trouble in a complex control hookup. In general this necessitates an instrument man of higher qualifications than commonly required in the past.

To meet this condition it is necessary to conduct schools for the joint training of new operators and instrument personnel. Advantage should also be taken of the schools maintained by instrument manufacturers, usually at their factory headquarters, for further specialized training of instrument men. This is especially necessary in view of many new types of instruments being installed and developed, such as electronic type potentiometers, aneroid type flow meters, spectrographic analysis, etc.

General Considerations

In designing the processes, a special effort was made to stabilize the system as much as possible by the use of flow control, with adequate surge capacity between elements of the process where liquid level control was necessary. Such stabilization, by maintaining smooth operation and minimizing cycling, cuts



The central control room or nerve center of a new fluid catalytic cracking plant of the Standard Oil Co. of New Jersey

*Presented at Symposium on Wartime Problems of Industrial Instrument Departments, American Society of Mechanical Enginers, New York, Nov. 30, 1943.

**Universal Oil Products Co., Chicago.

down on instrument maintenance.

An important factor in minimizing maintenance is the standardization of types of instruments and types and sizes of control valves, pressure gauges, etc. This accomplishes two highly desirable results:

1. Reduction of necessary spare parts.
2. Reduction in the amount of training required for instrument maintenance men.

Equally important are a number of other features which are often given little consideration, such as the following:

1. Provision of a well designed and engineered cleaning and dehydrating system on the instrument air supply. Elimination of freezing and plugging of pilot valves and air lines, especially during winter weather, should cut the average plant instrument maintenance by at least 50%.
2. Accessibility of instruments and control valves. An accessible instrument will be quickly corrected, whereas one poorly located may be left for the morrow.
3. Provision of cooling fins on hot control valve bonnets will reduce packing troubles.
4. Valve positioners contribute materially to smooth control where sticking is encountered. Valve sticking is often erroneously blamed on the control instrument.

New Problems

Hydrogen Fluoride Alkylation

Some of the processes used in the various aviation gasoline projects have brought new problems for the instrument maintenance man. The hydrogen fluoride alkylation process required development of a new technique for handling anhydrous HF and mixtures of acid and hydrocarbons at pressures and temperatures generally outside of those used in the previous handling of HF.

In view of the toxicity of HF and the corrosion products which cause sticking of close fitted moving parts, it was decided that instruments should be bottle-tight and that pressure-tight bearings would be unsuitable. Accordingly, torsion tube transmissions were selected for flow and liquid level instruments. After such preliminary selections, various types of valves, instruments, etc. were tested under conditions simulating actual service to prove suitability. Wherever possible standard equipment was used to keep from interfering with manufacturers' production schedules.

In plant operation, knowledge and control of liquid levels is highly important. Since gauge glasses are not usable in the presence of HF, displacement type float and differential type instruments have been provided to check each other. In field operation it has been found that the use of needle valve try-cocks, with proper precautions, is not as hazardous as at first believed. Observation of the material issuing from the try-cock distinguishes sharply between gas, hydrocarbon, and HF. This serves as a valuable occasional visual check on the instruments provided.

Purge System Employed

It is difficult and hazardous to pack control valves to hold HF, and since suitable packless control valves have not been available, a hydrocarbon purge system has been employed in conjunction with slightly modified standard valves using a lantern gland. The packing, therefore, does not come in contact with the acid.

Control valve material specifications play an important part. Monel or 18-8 stems, plugs and guide bushings minimize valve sticking. Carbon steel is fairly satisfactory where adequate clearance is provided, but the 14 chrome stainless steels commonly used as a standard oil refinery service trim are unsatisfactory because of excessive corrosion and sticking.

In order to reduce hazard and maintenance problems, an exhaust system was provided which can be connected at convenient points to evacuate lines before breaking into them.

Isomerization

Isomerization plants using combinations of aluminum chloride, HCl, and hydrocarbons present a series of problems to the instrument maintenance man comparable to those in HF alkylation plants in connection with sticking and corrosion. Provisions similar to those in the alkylation plants are being used to minimize difficulties.

Fluid Catalytic Cracking Units

In the fluid catalytic cracking units, the principal problem was the measurement of pressure, flow, and level of mixtures of catalyst dust with oil, oil vapors, air or gas. Purge connections between instruments and connecting taps through which a small stream of air or oil will flow to prevent catalyst from being carried into the instrument lines are used extensively. Measurements of flow in large lines where pressure drop would be undesirable are made by the use of air speed nozzles similar to those used on aeroplanes.

In the early days of the aviation gasoline program, orders by the War Production Board for the conservation of critical materials, especially chromium and nickel, limited the use of these materials as trim in control valves, safety valves, etc., except under special conditions. As oil refinery standards had generally been set up using stainless steels as standard trim, this necessitated making a given type valve with several alternate trims. This cut down on standardization and contributed to extended deliveries.

Replacement Factor

More recent orders relaxing the earlier requirements have recognized the fact that production is more important than conservation of the small amounts of critical material required for trim. However, many valves with substituted trims have been delivered on the jobs and will no doubt require replacement of the valve or trim in less time than would have been necessary had it been possible to follow the usual specifications.

Standardization of pressure gauges at the order of the WPB has reduced the number of types available, minimizing spares required. An overall decrease in maintenance should result where a better class gauge is used in a wider range of services.

Recommendations by PAW to use manually operable control valves to eliminate the use of full bypasses and blocks will have a far reaching effect on plant operation and maintenance. These recommendations were adopted widely by industry, in order to assist in reducing the overload on valve manufacturers. It is probable that within a reasonably short period of operation many such control valves will be fully fitted with bypasses after shutdowns caused by packing or stem failures have been encountered.

Orders Distributed

Preferred instrument and valve suppliers were overloaded with orders, due to the wartime demand, hence it was necessary through governmental directives to distribute the demand sufficiently to make use of available capacities in other companies. This has resulted in some lack of standardization.

The burden on a limited instrument maintenance department can be cut down by consideration of the foregoing points during design and construction of new plants as well as by the provision of adequate spares and a properly trained personnel.

Some Experiences in Starting Up Recent Process Units*

741.4

By H. F. Moore** and W. C. Ludi**

THE WAR EFFORTS of the petroleum industry have, to a large extent, involved the use of processes which bring with them interesting and difficult problems in measurement and control. In the production of such war materials as aviation gasoline, butadiene, rubber and toluene the processes have varied sufficiently from those of pre-war days as to demand, in many cases, a radically different approach in the application and operation of automatic control instruments.

In the production of the above materials, it is necessary to fractionate light hydrocarbons such as butanes, butenes, propylenes and ethylene. In producing these components we have the problem of fractionating and controlling hydrocarbon mixtures with very narrow boiling ranges and, therefore, with no appreciable temperature range for a particular pressure. During the operation of a recent plant it was necessary, to meet the requirements of purity of product, to control the pressure at the center of a 60-plate tower within 1/10 psig at approximately 30 psig.

A temperature control point was also included at the same point as the pressure and which reset a flow controller controlling the amount of product taken out of the reflux drum. A level controller was installed on the reflux drum controlling the rate of reflux to the tower.

With this system the temperature at the center of the tower is being controlled indirectly by the rate of withdrawal from the unit. The tower pressure controller operated a control valve on the water outlet of the overhead condenser.

Special Instrument Used

The pressure instruments which were available incorporated pressure responsive elements having a guaranteed accuracy of ½ of 1% of their range and with a sensitivity somewhat better than the accuracy but still not approaching the requirements. It can be seen that the commercial instruments available would not be suitable for the sensitivity and accuracy of pressure desired and, therefore, it became necessary to obtain instruments of a special nature. In the above case, an instrument using the pneumatic null balance system was obtained with a 10-lb range, suppressed for the operating pressure. After the initial adjustments were made to the system, pressure records and product tests indicated the control was within .025 pound. With the pressure controlled within such close limits the remainder of the controls on the unit operated very satisfactorily.

Since the operation of this pressure controller was the critical point in the successful operation of the plant, extreme care was taken in its installation and maintenance and it was somewhat babied along until the desired character of operation was obtained. It became very apparent in this installation that its instrument air must be free of dirt, oil and moisture. On this unit it was demonstrated on several occasions that hand control of any important process variable produced totally unsatisfactory results, and as a consequence all major control instruments must function for satisfactory unit operation.

Control of Refrigeration

In addition to the problems in fractionating light hydrocarbons, some processes require large refrigeration systems. Many factors enter into the control of such a system, the first important factor being the cooperation of the level controllers in the coolers, some of which operate as low as —140 to —150°F. It was determined in a recent plant that neither the conventional external ball float nor the displacer type were suitable, due to excessive boiling in the chamber and lower balancing line.

In the majority of cases where accurate and stable level control was necessary the differential type was finally installed. Many methods of installation were tried and it was finally determined that the most suitable method was to operate with dry legs on the manometer leads. This was accomplished by two methods: first, heating of lead lines by steam jacketing or steam tracing; second, use of a hot blowback gas, which constitutes the bubble system. The first method has the disadvantage of adding a considerable heat load to the system.

The second important factor in controlling a refrigeration system is the suction control of compressors. The experience recently obtained has been with gas engine driven compressors, where the suction pressure is controlled by varying the speed of the compressors. In all cases this was accomplished by the installation of a diaphragm motor to vary the spring tension of the compressor governor. Much care should be taken in adjusting the diaphragm to the governor and to be sure that the governor is functioning smoothly and is free. In a recent plant a great deal of trouble was experienced with suction control. After much work the trouble was traced to the poor operation of the compressor governors, which were of excellent design but during construction were left unprotected from the weather and had become rusted and filled with dirt.

Tying In Batch Equipment

Certain of the newer process units involve the inclusion, in a primarily continuous process, of equipment which itself inherently must operate on the batch principle, being alternately shifted from "reaction" to "regeneration" or vice versa. In tying the batch equipment into the continuous process a fairly complex timing mechanism is employed, which utilizes cam thrown switches to actuate the starters of motor operated valves and to check, through alarm contacts on the valves, to insure proper operation of the valves. The use of cams is feasible for this job only because all valve operations occur during a limited time, thus allowing the cams to rotate rapidly a full 180° on each "transfer" portion of the cycle, and then stop completely during the much longer "normal operation" portion of the cycle. For this service timing accuracy of one second was desired. Four-inch cams and mercury bottle switches were built into the timer.

It was very quickly determined, on starting the process unit, that the one-second accuracy was not obtainable, and dependability was very poor. By recutting the cams to get the fastest possible switch operation it was possible to use the timer, but only by allowing more than a desirable time tolerance in the alarm and check circuits. With 4-in. cams it was definitely determined that mercury bottle switches could not time to one or even two seconds. As changing cam size would have meant a completely new timer, the 4-in. cams were retained and the switches

*Presented at Symposium on Wartime Problems of Industrial Instrument Departments, American Society of Mechanical Engineers, New York, Nov. 30, 1943.

**Standard Oil Development Co., Elizabeth, N. J.

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Instrument panel in a boiler house at the Baltimore refinery of the Standard Oil Co. of New Jersey

★ ★ ★

changed to the spring finger, open contact type. These allow timing to the one second originally stipulated.

Rubber Plant Problems

In the production of rubber, several difficult problems arise. The most interesting is the handling of liquid streams containing small rubber-like particles after the reaction has taken place. In one particular case where the flow was controlled, Venturi tubes were used as the measuring element. On the lead lines to the manometer a suitable wash back was installed to keep them free of the rubber particles or latex.

The design of the control valves installed in the lines handling the rubber particles in slurry form was somewhat special. The valves used were basically the angle Venturi type with the plug modified so that it was in the form of a cylinder plug, with the side of the plug facing upstream tapered off so that the opening dimensions would be as large as possible for all port areas, thus allowing the particles to pass, instead of being "strained out", with consequent plugging. In order to prevent sticking in the guides, flushing connections were installed which kept all rubber formation from accumulating at these points.

In the manufacture of aviation gasoline, similar valves were required to handle a slurry of oil and small granular particles. In this case control valves were used in a known troublesome service with high pressure drops and a severe erosion problem, to get around the use of more than one pump in the slurry service. It would be possible to eliminate the slurry valves by having a turbine driven pump in each line and controlling turbine speed, but it was felt that a properly designed valve would require less maintenance than a pump in such a service.

Today more than ever before, trouble is being experienced in the refineries due to lack of sufficient trained instrument personnel. With the sudden increase in construction, it has been necessary for the instrument departments of the refineries to spread their better instrument men over a wider area, thereby reducing their effectiveness. A great many of the instrument groups have lost a large number of their first and second class men to the Armed Forces, which loss was made up with men obtained either from the outside or brought up through the ranks. These replacements for the most part are untrained and inexperienced in the basic principles of instrumentation. Consequently, the instrumentation within the plant itself, being greatly expanded, is considerably hampered by the inability of the instrument men to cope amply with the maintenance of the instruments, to say nothing of the problems which are brought on by the new process requirements of instruments.

Thus, more than ever before, a good training program should be carried on. Without it, the inexperienced and untrained men have to obtain their information by the trial and error method, which is long, expensive, and generally unsatisfactory. A good training program can be incorporated in an instrument department, and it must have as a foundation certain basic principles. The first principle to establish is to see that the trainee has an opportunity to learn under good supervision, on equipment set aside for the purpose. A common mispractice is to attempt to demonstrate on "live" equipment, which has a unit under control.

A second major point, which should need no mention, but which is frequently overlooked, is to organize the material with the simple maintenance problems and mechanical details first, then very gradually leading up to the control applications. With most training programs encountered thus far the aims have been set far too high for the newcomer to the field. Until a reasonable background of experience is obtained there is little point to dwelling on the intricacies of the application engineering.

It is important, however, that each man be familiar with the operation of the particular unit on which he is expected to work. He should be given an engineering flow plan and the process described to him by flow rather than by the chemical aspects. If he absorbs the information given him from such a set of instructions, he will be better qualified to know what an instrument is expected to do and how it should function with the rest of the unit.

Training Instrument Men For Government Magnesium and Styrene Plants*

By Robert W. Cermak**

741.4

IN EARLY 1942, The Dow Chemical Co. was faced with the necessity of procuring and training men to act in a supervisory capacity over instrument departments at the several government-sponsored magnesium and styrene plants projected at that time.

Magnesium is very much in demand for aircraft castings, forgings, extruded shapes and incendiaries. New plants for additional production were being designed for Velasco, Texas, and Ludington and Marysville, Mich.

Styrene, on the other hand, is one of the two major components used in the manufacture of "Buna S" synthetic rubber. Plants for additional styrene capacity were being designed for Torrance, near Los Angeles, Cal.; Velasco, Texas, adjacent to the magnesium plant previously mentioned; with a third plant for the Canadian government at Sarnia, Ont.

Since the processes used in both the magnesium and styrene plants were essentially continuous, it follows that a large number of automatic control instruments were incorporated in their design, to facilitate operation, keep operating personnel at a minimum and to insure correct specifications for the final product. As far as possible standard types of instruments were used, but in several cases at least, it was necessary to use special instruments and controls, previously developed by Dow for similar plants at Midland.

Personnel Considerations

Because of the number and complexity of the instruments and the very close interconnection between instruments and proper plant operation, it was felt technically trained personnel for the instrument departments was practically a necessity, particularly in view of the relatively short time available for training this personnel. Also, because of the size of several of the plants, it was felt two technical men should be used instead of one. In these cases we tried to choose men whose training would supplement one another —a good combination for these plants we felt would be to have one man a mechanical or electrical engineer and the other a chemical engineer. At the same time a spirit of competition would exist and at some later date the more outstanding of the two men could be chosen to supervise the department.

For those plants where only one technical man was necessary, we were desirous of obtaining a man who had taken an engineering physics course or a course combining physics and electricity along with a reasonable amount of mathematics and chemistry, and had had some actual shop experience with ability to do drafting and some design work.

Also, as far as possible, we were looking for the inventive and ingenious type of individual, having the ability to do things with his hands whether it be to build some material object or shoot trouble on an electrical circuit.

The majority of men were selected by our technical personnel director after interviews with graduates at their respective colleges or universities usually arranged through the college placement bureau. In other cases interviews were arranged with promising students on the recommendation of the departmental heads. Permanent record cards were usually examined beforehand to obtain information concerning subjects and scholastic standing.

Applicants' Qualifications

However not all our men were acquired in this manner. In one case, at least, an employe of a midwestern company, having read of our projected plants, contacted us requesting additional information. His application appeared sufficiently promising that an interview was arranged and the man subsequently hired. Previous flowmeter training which this man had plus his industrial experience gave him considerable advantage over the rest of the trainee group.

Two of our plants were located in Texas, and, since we were quite aware of the motto "Texas for the Texans", men for the several plants were chosen as far as practicable, from the section or locality in which the plants were being built. In this way, no great change in environment would be necessitated, except for the training period at Midland, and the men would be more satisfied and we felt more permanent in their new positions.

As a final confirmation, each man was interviewed on his arrival in Midland by the head of the Process Instrument Department, before a definite training course was assigned. However, our initial selection had been sufficiently careful that no changes were indicated at this point.

16-Week Training Course

To thoroughly acquaint the new men with such things as shop methods and practice, shop organization, the handling of men, employer-employe relations, laboratory analysis, pilot plant operation and general plant maintenance, all men were put through a general training course which covered approximately 16 weeks. This also gave us the opportunity to watch the men under actual working conditions and to obtain first hand opinions of the supervisors under whom they worked. It was thus possible to spot a man's so-called "weak points" and to concentrate on them in order to turn out a well-rounded individual.

To this end, each of the trainees spent time in the pipe, boiler and machine shops; the main and physical research laboratories; and the instrument department. At the conclusion of each of the training periods, the student was required to hand in a written report which in some cases consisted of answers to a prescribed list of questions and in others to a fairly detailed write-up of the work done by him in that department. This report was carefully corrected and graded by the training supervisor who also graded the man on his character and ability. This information was forwarded to the personnel department for their permanent records.

The program herein outlined is an adaptation of a general student training course sponsored several years ago at Midland and which has been given either completely or in a modified form to all technical personnel hired since that time. The original program included a three-week period in the instrument department which was of necessity greatly increased since we were now interested in training instrument men.

Trained in Other Departments

Let us now take up the training in each of the departments in detail.

In the pipe shop each trainee spent some time with the shop superintendent learning the organization of the department, the classes of work encountered and how jobs of various types are handled. Several days were spent in the pipe stockroom to thoroughly acquaint

*Presented at Symposium on Wartime Problems of Industrial Instrument Departments, American Society of Mechanical Engineers, New York, Nov. 30, 1943.

**Instrument Engineer, Dow Chemical Co., Midland, Mich.

the student with the various types of valves, pipe and fittings used in the plant. A week was spent in the shop proper where the trainee assisted the shop foreman and gained experience in handling men and the operation of shop equipment such as bending, threading and nipple machines and the various types of welding equipment.

To gain field experience, the man was next assigned to a fitter with whom he spent two weeks as a helper.

Training in the boiler shop was somewhat limited and consisted primarily of a study of gas and arc welding of steel and some of the more common alloys both in the shop and in the field. Additional experience was gained by assisting in the repair and retubing of one or more heat exchangers.

Two weeks' time was spent by the trainees in the machine shop. The first week of this period was spent as a machinist's helper doing field repair of various types of pumps, compressors and similar equipment. The first half of the second week was spent doing bench repair work in the shop. This usually consisted in helping disassemble and completely overhaul a centrifugal pump. The student was also required to prepare and to rebabbit one or more bearings. The second half of the week was spent doing minor machine jobs on the lathe, drill-press or shaper.

In the main laboratory, the student became familiar with the various methods of control analysis commonly used in the particular plant to which he would be assigned. Actual plant control samples were given to the student for analysis and report. One or more complete distillation and gas analysis were made by the trainee to thoroughly acquaint him with the methods and equipment used in doing this type of control work.

Operate Pilot Plants

At the time the training course was in progress, the physical research laboratory was working on several minor improvements which it was felt would be advantageous to incorporate in the plants then under design. To insure there would be no so-called "bugs", pilot plants had been set up in which these improvements could be tested under actual operating conditions. Since all major instruments and controls had been incorporated in these pilot plants, the trainees while testing the new developments, obtained more first-hand information on the interconnection of instruments and process than could have been received any other way. The usual continuous chemical process presents an overwhelming array of stills, columns, heat exchangers and pumps with interconnecting piping which is almost hopeless to trace. Here was an operating plant in all its essentials in which one could readily study the effects of one control upon another and also upon the whole process in general. Each of the trainees spent approximately three weeks operating and studying these plants.

Learns Methods of Analysis

The remaining three weeks in the physical research laboratory were divided between the electrometric laboratory and the laboratory drafting room.

In the electrometric laboratory, the trainees became familiar with the more highly specialized methods of chemical analysis such as electrometric titrations, polarographic analysis and electrical conductivity measurements. Instruction was also given on maintenance and servicing several special instruments and controls which had been developed by this laboratory group primarily for these particular plants.

During the period in the drafting room, the students plotted graphs and made sketches for reports and worked on some current design problem, preferably one dealing with some new instrument or automatic control development.

At the completion of this preliminary training, the students were transferred to the process instrument department and the remainder of the instruction was given either in this department or under its supervision.

Trainees were usually started on the gage repair bench where they repaired and recalibrated several pressure gages. From this the students graduated to the checking of recording thermometers to the manufacture of thermocouples and finally to doing minor repairs and calibration of instruments brought into the shop.

Serve As Helpers

To obtain first-hand experience on maintenance and repair of instruments in the field, the trainee was placed as a helper under the supervision of a maintenance route man. His work in this capacity was quite varied—it might consist in replacing a thermocouple or lead wire, replacing a filter or air reducer, assist in making major mechanical or electrical repairs to a recording potentiometer, flow controller, or the safety equipment on some gas-fired heating oven. Much of the student's instruction was obtained either by actually working with some particular instrument, verbally from the shop or field foreman or from the man for whom they were working. This instruction was supplemented by the department files which yielded catalogs, wiring diagrams and instruction bulletins for the more complicated systems.

The student's training seldom followed a prescribed course. The men were shifted from job to job in order to round out their experience as much as possible. The trainees as a whole assimilated information quickly enough that in a relatively short time they could be depended on to do minor jobs alone, such as the installation of a recording thermometer or simple controller or to handle a service call.

Instrument installation on construction jobs at Midland is handled somewhat differently than in most other companies. Actual installation of instruments in a new plant, including setting up of the panel boards, mounting of instruments and the running of electrical conduits and piping and all testing are done by an outside contractor. However, all work is supervised by and subject to the approval of the instrument department, which upon completion of construction prepares the instruments and controls for service and assists the operating personnel in placing the plant in operation.

Study Plant Construction

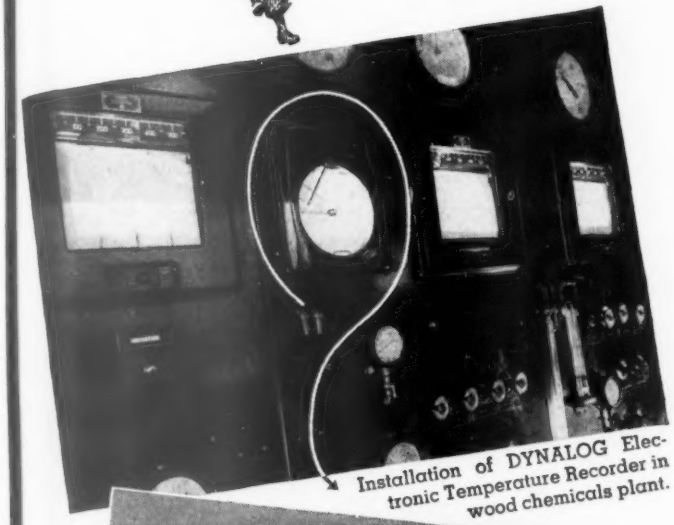
We were extremely fortunate at this time in having under construction plants for additional styrene production capacity at Midland. This afforded the students an excellent opportunity to follow the actual construction of a plant from start to finish and gave them training which was extremely valuable later on when they were called upon to supervise instrument installation in the government plants.

Advantage at this time was also taken of the training courses offered by three of the instrument companies. Each of the courses covered a period of one week and included lectures on specific types of instruments with practical instruction on their maintenance and repair. The lectures were supplemented with demonstrations of actual instruments with which the students became familiar by being permitted to make adjustments and repairs. Instruction was also given the students on flow measurement, including orifice plate calculations, pyrometry, control valve design and the fundamentals of automatic control.

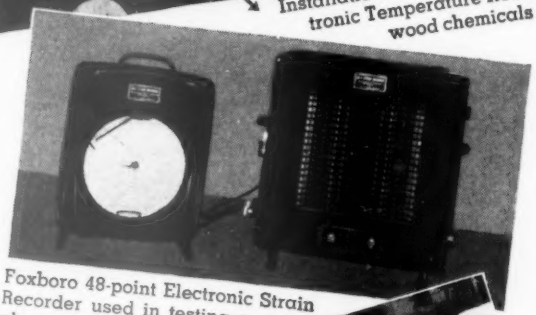
When the trainee group returned from their eastern trip the Midland plants were rapidly nearing completion and were soon ready to have the instruments prepared for service. This work

Let's Get Down to Earth

ON ELECTRONIC PROCESS INSTRUMENTS!



Installation of DYNALOG Electronic Temperature Recorder in wood chemicals plant.



Foxboro 48-point Electronic Strain Recorder used in testing warplane wings.

Verigraph Electronic Recorders widely used in paper and rubber industries.

No "revolution" likely... but Foxboro progress points to important specialized advances

There's little likelihood that electronic instruments will soon replace all of today's standard industrial instruments. The majority of processes require no radical improvements in instrumentation. Yet, Foxboro's pioneering research already has demonstrated how electronic sensitivity can importantly increase the usefulness of instruments for some applications ... and make possible *the first practical instrumentation ever available* for others!

For example, rubber and paper industries have used Foxboro's Verigraph Electronic Recorders for many years, to obtain weight-and-moisture measurements never before available. In wartime chemical production, Foxboro Electronic Temperature Recorders now furnish records that can be read to 1/10°C. And in leading warplane plants, other Foxboro Electronic Instruments enable exact readings of wing strains at 48 test-points, almost simultaneously!

Today's production of these instruments is focused on war applications. Tomorrow, these and other measurement-and-control advances will be available to all industry, in Foxboro's new DYNALOG Electronic Instruments! **The Foxboro Company, 56 Neponset Ave., Foxboro, Mass., U. S. A.**

DYNALOG measurement and control by FOXBORO

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was done entirely by the students under the supervision of an experienced instrument man.

During the starting up period, the students were placed on shifts in order to have one or more instrument men on duty at all times. Experienced men, however, were on call should an extremely unusual condition arise. The plants as a whole started up with no more than the usual amount of difficulty and with a minimum of assistance from the regular instrument department personnel.

Training Is Adequate

By the time the Midland plants were operating smoothly several of the government plants were far enough along in construction to require supervision of instrument installation. The instrument men for these new government plants were transferred immediately to their permanent locations.

The remainder of the trainee group occupied their time by brushing up on certain phases of instrument work which were not quite clear, checking over flowsheets and blueprints of their respective plants, going over the equipment, tool and spare parts lists for their departments and checking on instrument deliveries. One group prepared the majority of their permanent instrument records before they left Midland while another made up detail drawings showing the instrument piping behind each of the panel boards with the location and method of supporting each of the instrument lines from the panel board to its connection into the process piping.

Personnel Problems in Operation Of an Instrument Department*

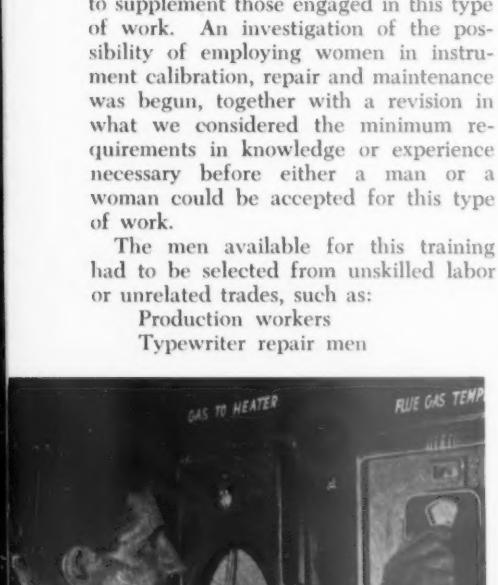
*By G. P. Bosomworth***

741.4

IN PRE-WAR DAYS the sources of instrument mechanics were generally other skilled trades, particularly pipe fitters, stationary engineers and tool makers. Today, men with this background are not available. The rubber industry was no exception with regard to the scarcity of skilled help for instrument service. It became evident in the early part of 1942 that a program would be required which would furnish men to supplement those engaged in this type of work. An investigation of the possibility of employing women in instrument calibration, repair and maintenance was begun, together with a revision in what we considered the minimum requirements in knowledge or experience necessary before either a man or a woman could be accepted for this type of work.

The men available for this training had to be selected from unskilled labor or unrelated trades, such as:

Production workers
Typewriter repair men
Musical instrument repair men
Laborers
Watchmakers
Automobile mechanics
Plumbers helpers
Salesmen
Service men for stokers
Domestic refrigerator service men
Timekeepers
Utility meter readers
Railroad brakemen



The training period lasted for 6 weeks, during which time the employe attended a class for 4 hours, and worked in the factory with an experienced man for the other 4 hours. A collection of representative instruments, cycle controllers and valves was gathered and set up in such a way that calibration, operation and trouble shooting could be demonstrated. It was found necessary, in most cases, to teach these men the names of pipe and copper tube fittings. The training included rules on safety, and throughout emphasized the thought that maintenance should not be a policy of temporary expedience.

Facts on the available factory services and pressures, or other characteristics were given. The trainee was instructed in the method of approach to a problem in maintenance, so that he did not over-extend his limited knowledge by the hunt and peck system of trouble shooting. It is realized, of course, that the training of any instrument man to handle any of the normal situations which arise in such work requires two or three years training, and to condense this into a short period of a few weeks is impossible. However, it was believed that with a nucleus of experienced men, the situation could be met in large part. There was available a limited number of men who had been hired before December, 1941, who were learning the trade in the normal manner, and we relied on these men as a further support for the operation of the instrument division.

It was found that 50% of the men hired as trainees were both desirous of continuing in the work and at the same time were able to make progress in acquiring the necessary knowledge. About 15% of the trainees hired have been able to extend their knowledge to cover the complete instrumentation in some of the newer plants in a period of 15 months. These men can be classified as experienced. By an experienced instrument man is meant one who not only understands the instruments, but also understands the processes where they are used.

Women Were Trained

Further expansion in manufacturing facilities created an increasing need for more personnel. This was accentuated by the further demands of the armed forces, who found it necessary to take some of the newly trained men. It was then decided that women would be hired for training in some phases of instrumentation. Changing recording instrument charts are handled in part by women. Watchmakers engaged in precision instrument work were augmented by the training of women. The calibration of pressure gages and temperature recorders, and repair of dial micrometers was taken over in a large degree by female help. As these women obtained skill in the use of instruments and small tools, it was found possible to train them in the repair and reconditioning of cycle controllers, dial micrometers, thickness gages and time clocks. The selection of female help was made from:

Grocery clerks
Punch press operators
Dairy laboratory assistants
Department store clerks
Recent high school graduates with no experience

With the rearrangement of some of the work in the department, providing special jobs for those with limited knowledge and experience, with the use of women for some of the jobs requiring manipulative skill, with the spreading of the skilled help among the unskilled, it has been possible to operate without too many objections from the departments depending upon the services of the instrument division.

From our experience to date, it would seem that the training period for instrument work can be speeded up only if we limit the scope or the range of work required from a trainee of the instrument personnel.

We planned our training program to meet the exigencies of the emergency. While many new angles and possibilities have come to light, we believe that the condensed training period would not be advisable as a substitute for the normal course in peacetime conditions.

*Presented at Symposium on Wartime Problems of Industrial Instrument Departments, American Society of Mechanical Engineers, New York, Nov. 30, 1943.

**Engineering Laboratory, Firestone Tire & Rubber Co., Akron, O.

The Progress of the Liquefied Petroleum Gas Industry in 1943

Despite the vicissitudes of war, the liquefied petroleum gas industry continued to expand in 1943 in both the domestic and industrial fields. Data on LPG consumption in chemical manufacturing is not available under wartime conditions but large increases were made particularly in rubber chemicals and aviation gasoline manufacturing.

Although there are restrictions on domestic installations, consumption increased in this channel. Use of LPG for gas manufacturing gained at about the rate of previous years. Use of propane in metal cutting operations was a factor in speeding work in shipbuilding yards.

In the distribution field wartime economies by the LPG companies have conserved manpower and automotive equipment. The annual reviews of the liquefied petroleum gas industry by this authority for several years have been a feature of the literature on this subject.

G. G. Oberfell

*By G. G. Oberfell**

MARKETED production of liquefied petroleum gases for fuel and miscellaneous purposes is estimated to have increased 19% in 1943 over 1942 to 635,000,000 gal. This estimated increase of 102,600,000 gal. is made on a different basis than in this author's previous annual reviews. Details of the estimate are shown in Table 1. Changes in the industry make it appear desirable to modify former methods of reporting marketed consumption. Heretofore estimates included LPG used in chemical manufacturing only when delivered in liquid form. Deliveries in gaseous form by pipeline from oil refineries and natural gasoline plants were not reported. This year all LPG used in chemical manufacturing has been eliminated from the estimates.

In 1942 the chemical manufacturing industry used 53,038,000 gal. of LPG delivered in liquid form by tank truck and tank car. Chemical manufacturers also processed large volumes of gaseous hydrocarbons in the LPG range delivered by pipeline from refineries and gasoline plants. In 1943 there was an unusually large increase in consumption of LPG by chemical plants. Estimation of the amount used, however, is made difficult by duplications arising from inter-plant movement for partial processing. Publication of data regarding some phases of chemical utilization of LPG probably would be undesirable during wartime.

In general it may be said that rubber and aviation gasoline consumed rapidly increasing quantities of butanes and propane, particularly in the last half of 1943. Twelve butadiene plants charging butane and butylene were completed and placed in operation in 1943. Synthetic rubber output increased more than tenfold between the first and fourth quarters, from 10,486 (1) tons in the first quarter to 123,300 tons in the fourth quarter. As previously stated LPG use by these plants is not included in the present estimate. Concurrent with the building of synthetic rubber plants the oil industry has been building aviation gasoline plants requiring butane and butylenes. Isomerization of normal butane for subsequent alkylation with butylenes caused the diversion of a tremendous quantity of butanes from other uses.

Consumers Switch to Propane

For several years the relative volume of propane sold for LPG purposes has increased and the relative volume of butane has decreased. In 1943 this trend was accentuated. Industrial consumers used products containing a larger percentage of propane or switched from butane to propane where propane tankage was available. In a few instances 80-lb. storage was replaced by 200-lb. working pressure storage at industrial plants to permit conversion from butane to propane.

Although new domestic installations were subject to governmental approval a considerable number were made in 1943. Defense housing projects accounted for many new individual consumers. Government approval was given also to conversion of gas appliances to liquefied gas when consumers moved away from gas lines. New installations were approved in areas where no other fuel was readily available.

Domestic installations at the close of 1943 are estimated to total 1,900,000. This is an increase of 75,000 over last year's estimate. Part of the increase was due to correction of the previous estimate and part to new installations. About 5000 new buried tank installations were made in the South. In Oklahoma, for example, 700 new installations were inspected by the State Fire Marshal in the first 10 months.

Gain in Gas Manufacturing

Use of liquefied petroleum gases by public utilities for gas manufacturing continued to increase at the rate of about 24% per year. Gas utilities have been confronted with unprecedented demand from war industries and domestic consumers. On the Pacific Coast gas utilities increased their purchases of liquefied gases 10% in addition to the 70% increase the previous year. In the Middle West one utility recently installed two diluters having an output of 5,000,000 cu. ft. of propane-air gas per day. The same company also is mixing propane with water gas for underfiring a battery of four coke ovens and is enriching water gas for general distribution. This one company proposes to use 5,000,000 to 7,000,000 gal. of propane in 1944.

Natural gas distributors experienced shortages during the past winter at peak load periods. Where natural gas was short, the cause in most cases was lack of adequate long distance pipelines or pipeline breakage rather than an actual shortage of gas. One result of last winter's gas shortage was the demand for a considerable number of propane standby installations. Two large military camps in Oklahoma now served with natural gas installed stand-bys in recent months. One of these plants has storage capacity for 100,000 gal. of propane and another has 50,000 gal., 10 days' supply in each case.

When steel once more is freely available it is expected that there will be a considerable increase in the use of propane or butane for cold carburetion. Plans are known to be afoot for conversion of a number of town gas plants from manufactured gas to butane-air or

* Vice President in charge of research, Phillips Petroleum Co.

(1) Progress Report No. 4, War Production Board, Office of Rubber Director.

TABLE I—MARKETED PRODUCTION OF LIQUEFIED PETROLEUM GAS

Year	Total Sales Gallons Per Year	% Inc. Over Prev. Year	Distribution—Gallons Per Year: Domestic	% Inc. Over Prev. Year	Ind. and Misc.	% Inc. Over Prev. Year	Gas Mfg.	% Inc. Over Prev. Year
1922	222,641	....						
1923	276,863	24.4						
1924	376,488	36.0	Sale of liquefied petroleum gas					
1925	403,674	7.2	confined primarily to bottled gas					
1926	465,085	15.2	business prior to 1928					
1927	1,091.005	134.6						
1928	4,522,899	314.6	2,600,000	....	400,000	....	1,500,000	....
1929	9,930,964	119.6	5,900,000	126.9	1,500,000	275.0	2,500,000	66.7
1930	18,017,347	81.4	11,800,000	100.0	2,200,000	46.7	4,000,000	60.0
1931	28,769,576	59.7	15,294,648	29.6	7,171,686	226.0	6,303,242	57.6
1932	34,114,767	18.6	16,244,103	6.2	8,167,194	13.9	9,703,470	53.9
1933	38,931,008	14.1	16,625,588	2.3	13,987,095	71.3	8,318,325	—14.3
1934	56,427,000	44.9	17,681,000	6.3	32,448,000	132.0	6,298,000	—24.3
1935	76,855,000	36.2	21,380,000	20.9	47,894,000	47.6	7,581,000	20.4
1936	106,652,000	38.8	30,014,000	40.4	67,267,000	40.4	9,371,000	23.6
1937	141,400,000	32.6	40,823,000	36.0	89,402,000	32.9	11,175,000	19.3
1938	165,201,000	16.8	57,832,000	41.7	94,983,000	6.2	12,386 000	10.8
1939	223,580,000	35.3	87,530,000	51.4	120,615,000	27.0	15,435,000	24.6
1940	313,456.000	40.2	134 018 000	53.1	159,153,000	32.0	20,285,000	31.4
1941	462,852,000	47.7	220,722,000	64.7	216,875,000	36.3	25,255,000	24.5
1942	532,402,000*	27.2*	299,559,000*	35.7	201,477,000*	16.7*	31,366,000	24.2
1943	635,000,000†	19.3	350,000,000	16.8	246,000,000	22.1	39,000,000	24.3

* Not including 52,904,000 gal. used for chemical manufacturing.
† Chemical manufacturing consumption not included.

Remarks: In the above table "Total Sales" for all years except 1943 were obtained from U. S. Bureau of Mines reports. "Distribution" for the years 1931 to 1942, inclusive, was obtained from the same source. All other volumes are estimated by the writer. The total sales volume includes all liquefied petroleum gases (propane, butane, and propane-butane mixtures) when sold as such. It includes the sale of pentane when sold for any purpose other than motor fuel blending. It does not include butane when blended with heavier petroleum fractions for motor fuel purposes. Inter-company sales transactions, such as purchases of liquefied petroleum gases by one company from other companies and then resold as liquefied petroleum gases, have been eliminated in order to avoid duplication of sales figures. The data do not reflect sales of liquefied petroleum gases used directly by the producer at the point of production, for fuel, polymerization, solvent de-waxing, etc. Neither do the figures include sales of hydrocarbons to chemical plants or to plants manufacturing synthetic rubber or aviation gasoline or their components.

propane-air or undiluted propane after the war.

Greater diversion of butanes to aviation gasoline and rubber encouraged refiners in a number of instances to use propane as a gasoline blending agent to obtain sufficient volatility. Experiments have shown that up to about 3% propane may be blended with motor gasoline to give good starting characteristics where butane supplies are deficient.

Industrial consumption of LPG suffered a brief slump early in 1943. The upward curve of demand was resumed after a short delay as activity increased, particularly at aircraft sub-assembly and parts manufacturing plants and shipyards.

Speeded Shipbuilding

The shipbuilding industry is an outstanding example of the use of liquefied gases to speed war work. It has been said by shipbuilders that propane has done more than any other product to speed the fabrication of ships. Propane has been used to augment and in many places to supplant acetylene for metal cutting operations. With oxy-propane torches cutting speed has been increased materially. The kerf is much smoother and thus does not require a grinding operation. The amount of slag to be removed is negligible. As an example of how this type of use has increased LPG demand, shipyards supplied by one company increased their propane consumption 53% in 1943 over 1942 which was, in turn, 170% greater than 1941.

In other operations replacement of fuel oil with liquefied gases has speeded preheating of plates and pipes for bending. With propane it is possible to keep work clean by eliminating carbon deposit and localizing heat. This is particularly true in Van Stoning operations. Other applications where propane has helped improve working conditions and reduce heating time include core baking, lead melting, forging small parts, submerged combustion in pickling baths, rivet heating, rivet washing, die casting operations, and many types of heat treating.

Used in Glass Making

Many of the increases in demand on the liquefied gas industry this past year were caused by the war but are not, strictly speaking, solely war demand. The glass industry is an example. The shortage of tin plate has diverted a great deal of packaging of food from metal to glass. In 1943 the glass industry manufactured about 13.4 billion (1) containers compared with 11.5 billion in 1942 and 8.0 billion in 1941. The glass industry is manufacturing millions of bottles for direct war consumption such as blood plasma containers, medicine bottles, etc.

Eight typical glass manufacturing companies had a prewar annual consumption of 770,000 gal. of liquefied petroleum gases. For the past two years these 8 companies have consumed 2,975,000 gal. per year. The companies in question were not converted from other fuels to liquefied gases so the increase largely reflects the expanded production.

Transportation has been a major problem of the industry in 1943. Additions to the fleet of pressure cars included 431 new propane cars, 110 new butane cars and 183 natural gasoline cars modified to permit transportation of butanes. Many of these new and modified cars were not delivered until late in the year. The industry could have supplied additional quantities to utilities and other industries had it not been neceesary also to provide transportation for large volumes of butane, butylenes and isobutane for the aviation gasoline program.

As the year progressed it was necessary to move ever increasing amounts of isobutane from natural gasoline plants to oil refineries for alkylation. Normal butane movement to isomerization plants also required pressure cars. The situation was complicated further by the lack of balance within the refining industry on the production of so-called B-B (butane-butylene) cuts. It was not possible to match butylene production with alkylation capacity at every point. One result was the necessity to ship butane-butylene mixtures from one refinery to another.

Overcame Emergencies

Two government directives designed to aid the war imposed an additional burden on the liquefied petroleum gas industry in the last quarter. Directive 75 requiring all butanes containing as much as 20% isobutane to be shipped to fractionating plants for separation of isomers reduced the total supply of butane available for conventional purposes and put an added strain on transportation facilities. The necessity for greater inter-refinery movement of B-B cuts caused the government to request all owners or operators of pressure cars to put 5% of their fleets into this refinery service. Most owners already were devoting large numbers of their cars to aviation service. By a superhuman effort the industry kept most customers from running completely out of LPG, although shipments in some cases were delayed.

Trucking operations of the industry have been increased both for transfer of B-B cuts between refineries and for deliveries of LPG to war plants and domestic consumers. Many manufacturers who formerly used tank cars are delivering 40 to 60% of their product by tank truck. Truck delivery operations have been complicated by the manpower shortage, gasoline and tire rationing and delays in obtaining repair parts.

In May, 1943, the Interstate Commerce Commission, in deciding the issue in I.C.C. Docket 28663, Green's

(1) Press release of Glass Container Institute.

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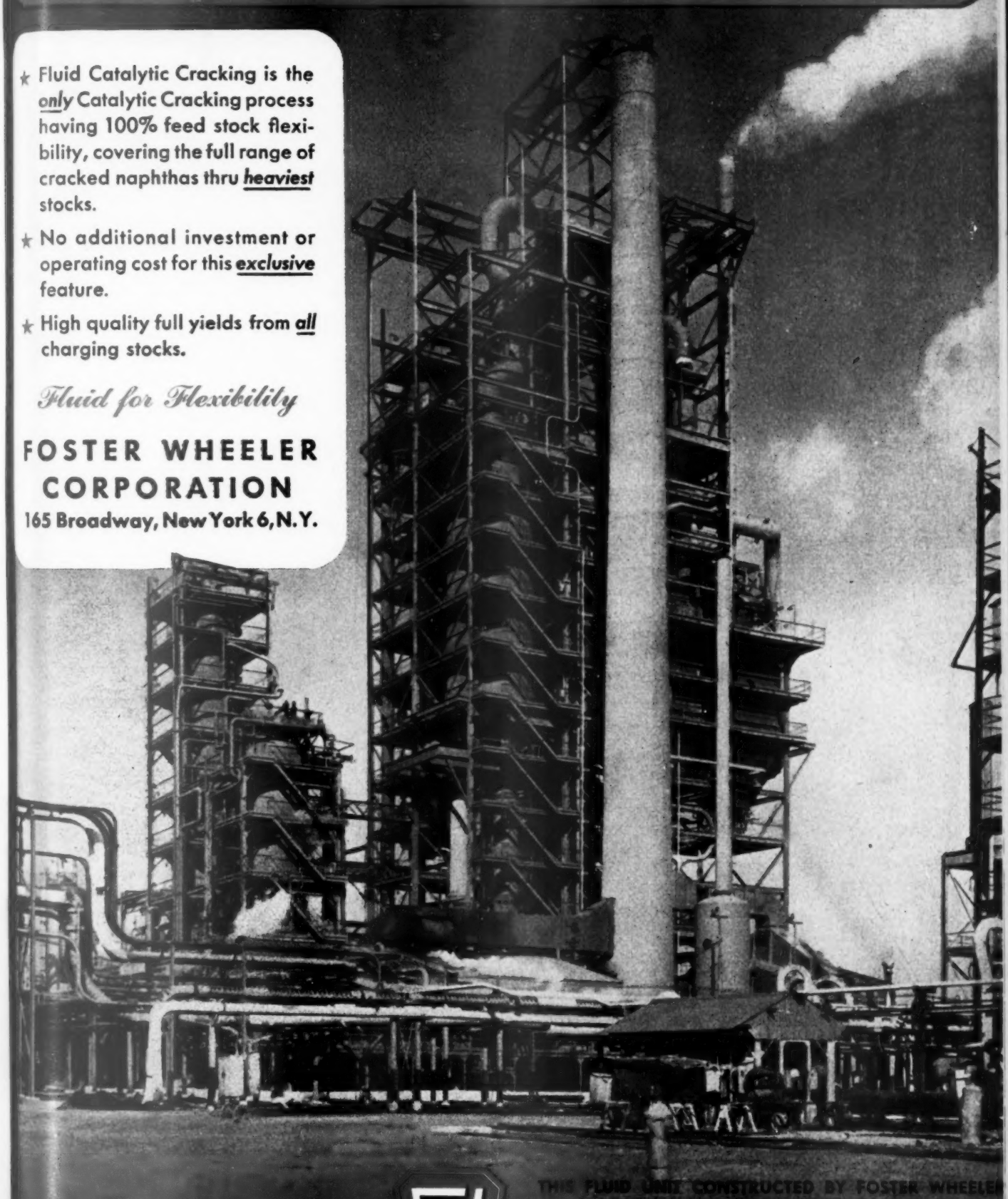

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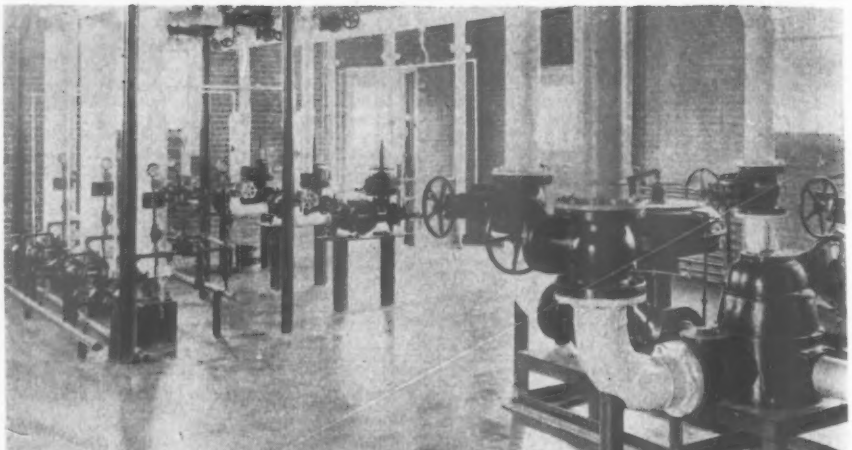
FOSTER WHEELER

Fuel, Inc., vs. Atlanta & Saint Andrews Bay Railway Co., et al, found the estimated weight of 6.6 lb. per gal. on liquefied petroleum gas from the Southwest to the Southeast unreasonable to the extent that such estimated weight exceeded 4.7 lb. per gal. Rail carriers filed tariffs to become effective Nov. 30, 1943, reflecting an increase of 40% in rates subject to an estimated weight of 4.7 lb. per gal., which would have resulted in substantially the same per-car charges as previously prevailed by the use of estimated weight of 6.6 lb. per gal.

Rail Tariff Reduced

The Commission, in I. & S. Docket 5271, suspended the increased rates but the estimated weight of 4.7 lb. per gal. has been permitted to become effective. Therefore, effective Nov. 30, 1943, the per-gallon charge will be approximately one-third less than prevailed prior to that date on shipments from southwestern origin points to the southeast, embracing substantially destination territory east of the Mississippi River and south of the Ohio River.



Interior of vaporizer house at an eastern steel plant. Propane from a battery of six 30,000-gal. storage tanks is vaporized and diluted with air to predetermined heating values in this equipment allowing for direct substitution for natural gas. Compressors (not shown) deliver the gas to heat treating furnaces at high pressure

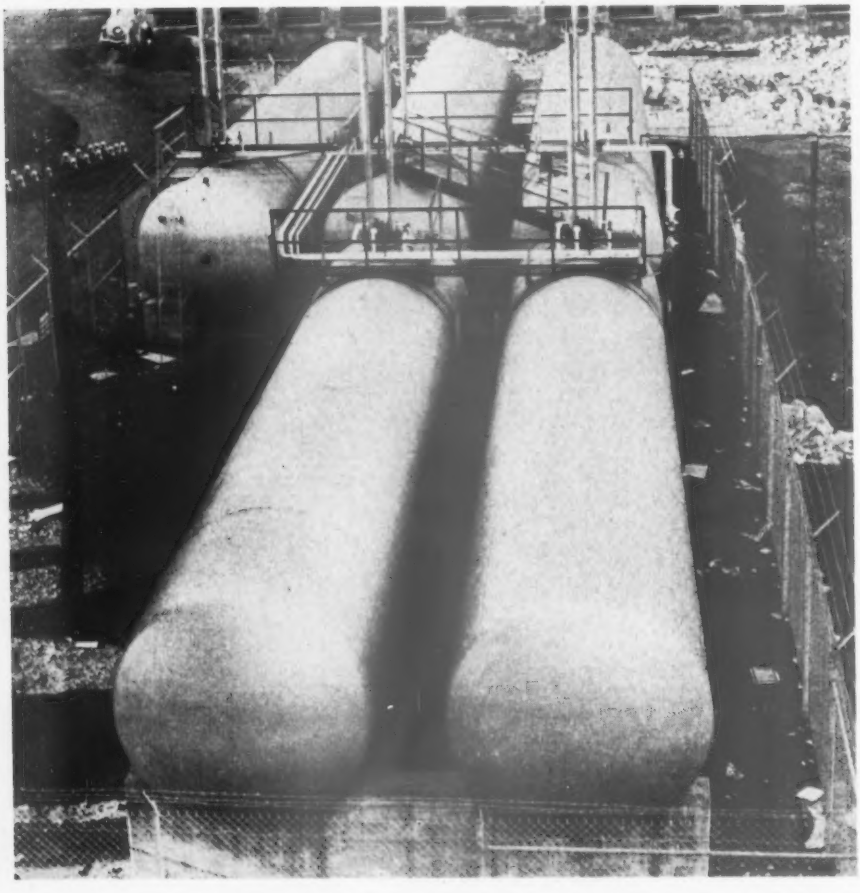
The manpower situation in the LPG industry, as well as in all other industries considered essential to the war effort, has been critical. The War Manpower Commission has recognized the industry as being essential resulting in some technical and key employes being granted occupational deferments for limited periods of time. However, the loss of men to the military services has been large and the ingenuity of management has been taxed to the limit in not only maintaining necessary services but increasing many of them where required in order to assist in prosecuting the war.

To co-operate with the government in the complete utilization of all available manpower, the industry has ceased all retail sales activities for the duration of the war. Service work has been reduced to a minimum. Management has taken extreme care, by thorough planning and giving close attention to details, to effect consumer deliveries in such a manner that manpower as well as tires and motor fuels can be saved and the necessity for vehicle repairs reduced to an absolute minimum. Women are being used extensively in jobs normally held by men. In some instances both office and field labor, as well as supplies and equipment, have been saved by billing retail domestic accounts every two months instead of the more frequent peacetime intervals.

Results of the various plans and methods adopted to save manpower have been surprisingly effective. The number of employes required by one company to carry on operations has been reduced 44% in 1943 when compared to 1941. Average gallons of liquefied petroleum gas delivered per employe in 1943 increased 123% over delivery per employe in 1941.

At the close of the year 1943, the industry is in the position of further "tightening its belt" in the face of greater demands by the War Manpower Commission for men for the armed services. A continuation of job studies, proper petroleum gas delivered per employe in skills of available men and women, in conjunction with intelligent and conscientious leadership, should make it possible for the industry to not only maintain its position but to make further advances under what might be termed adverse circumstances.

Ten new natural gasoline plants begun since the war were put into opera-



Propane storage tanks at a glass plant. Manufacturers of optical and other special glass for war instruments have found propane a superior fuel because of its purity and uniformity which eliminates bloom

tion in 1943 to increase materially the available supply of liquefied petroleum gases. Production was increased also by substantial additions to previously existing plants. Butane fractionating columns were installed where possible to increase the supply of isobutane for aviation gasoline manufacture. Refrigeration was added at some plants to improve efficiency of extraction.

Texas and Illinois added more new production of liquefied gases than any other state. Illinois production rose about 50,000,000 gal. Three large recycle plants in Texas added materially to motor fuel supplies as well as to production of isobutane, normal butane and propane. Two plants were built in Arkansas for the primary purpose of sulfur removal from sour natural gas to be used as fuel for war plants. Both plants are producing large quantities of liquefied gases as byproducts.

To aid the war program one Texas manufacturer tied a group of old gasoline plants together by pipeline into a central treater where isobutane was recovered in addition to normal butane and propane. Previously mixtures had been produced at some of the small plants in the system but the project largely increased the production of LPG for fuel as well as for aviation gasoline synthesis.

Another manufacturer increased production of LPG with a minimum utilization of steel by passing natural gas through absorbers in the field and circulating the rich oil to a gasoline plant several miles away, where still and fractionation capacity was available for recovering the LPG and natural gasoline. At the year's end an Illinois manufacturer was producing raw gasoline at a simplified plant using minimum quantities of steel and transporting the raw product to an older natural gasoline plant for fractionation.

Oil refiners have increased recoveries of LPG at many points although little of this increase in production is finding its way into normal LPG markets. Virtually all is being used in the manufacture of aviation gasoline or synthetic rubber. A recent report of the U. S. Bureau of Mines stated that use of liquefied refinery gases for fuel purposes decreased 30% in the first nine months of 1943.

East Coast refiners have made more propane this year than last since their crude supplies have increased through operations of the Big Inch pipeline and larger crude imports by tanker. Butanes manufactured by eastern refiners are being used almost exclusively for motor fuel or aviation gasoline.

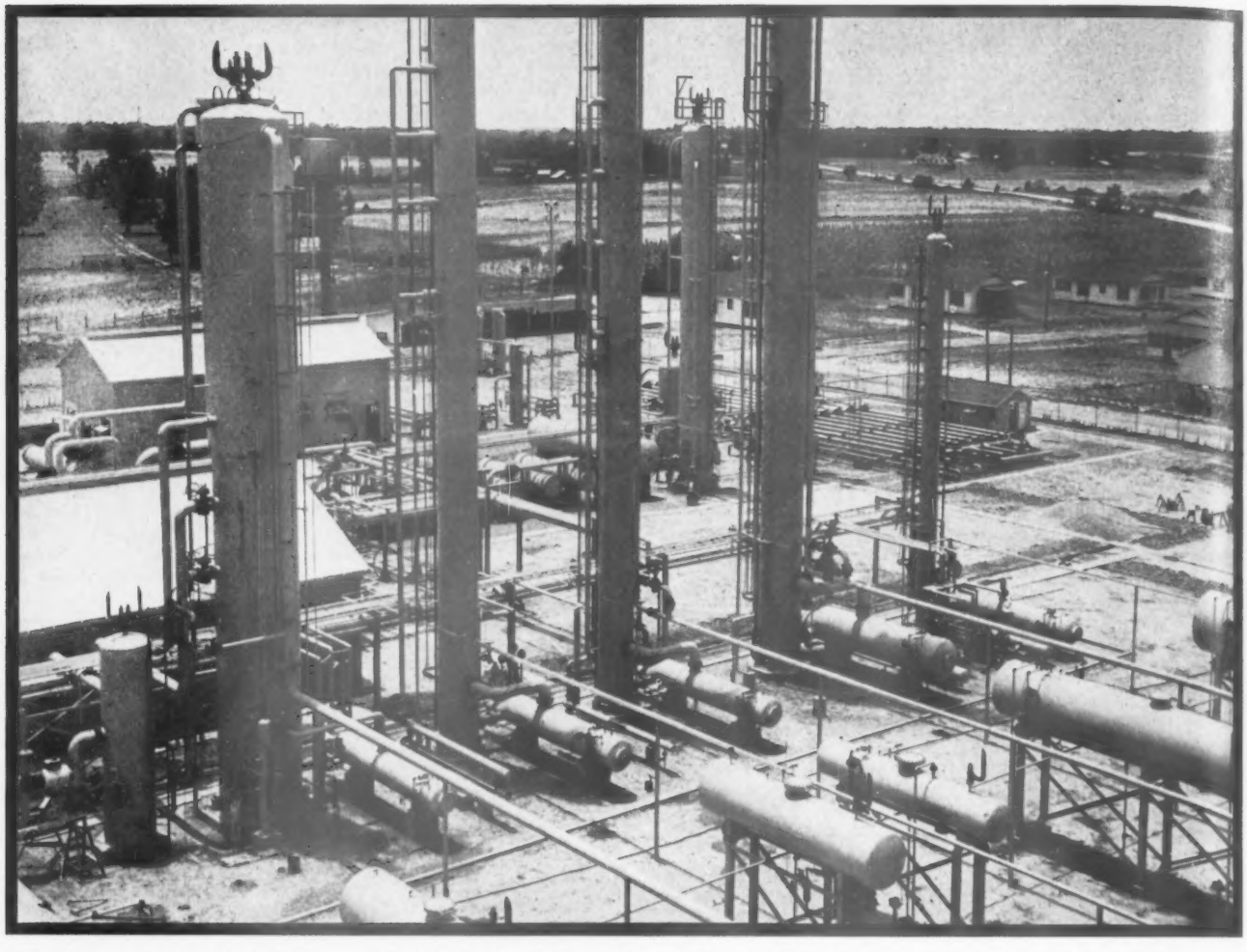
Industry Advisory Committees were established in the five PAW districts by Administrator Harold L. Ickes to advise the Petroleum Administration for War on various problems affecting the production, transportation and distribution of liquefied petroleum gases.

The Liquefied Petroleum Gas Assn. has continued to play an active role in the industry. Transportation and technical committees were particularly busy. The Technical and Standards Committee proposed revisions in National Board of Fire Underwriters Pamphlet 58 to provide rules for warehousing LPG cylinders and to clarify previous regulations.

State regulations and taxation measures affecting the industry were considered by legislatures in Kansas, New Mexico, Nebraska, New York, Minnesota, Wisconsin, Massachusetts, Arkansas, Georgia, Colorado, Texas and the District of Columbia. Action was taken affecting distribution in Arkansas, Georgia, Colorado, District of Columbia and Texas.

Considering wartime conditions the liquefied petroleum gas industry has served its domestic customers and war industries well. The year 1944 is expected to be a critical year for the industry with serious problems of manpower, transportation and supply to be solved.

On the right are the collecting tanks for the four butadiene units of the new synthetic rubber chemicals plant of Koppers United Co. at Kobuta, near Pittsburgh. Butadiene processing units are in right background. On the left side of the road is the plant which manufactures styrene by cracking ethylbenzene. Rated plant capacity is 80,000 short tons of butadiene annually and 37,500 tons of styrene



Fractionating area of Columbia gas treating plant. Left is still supplying raw feed for fractionators; left to right, depropanizer, debutanizer, de-isobutanizer and de-ethanizer towers. In right background is metering station for inlet and outlet gas

Propane, Normal and Iso-Butane Recovered in Gas Treating Plant

By Howell L. Phillips*

Propane, butane and iso-butane of over 95% purity, in addition to natural gasoline, are recovered as by-products of a plant extracting hydrogen sulfide from sour gas produced in southern Arkansas. The gas is passed through the purification and absorption units, the enriched oil after the stripped gas has been removed being treated in a heater, still and series of fractionators.

THE Arkansas Fuel Oil Co. recently placed in full operation its Columbia gas treating plant near Magnolia, Ark. This plant extracts the hydrogen sulfide from "sour" gas gathered from the fields in southern Arkansas so that the gas is suitable for domestic and industrial use in the war effort.

The plant has a capacity of 62,500,000 cu. ft. of gas per day, all taken from Macedonia and Dorcheat gas-distillate fields of Columbia county. About half of this volume at present is sour gas, the remainder is sweet gas. The sour gas, containing about 1800 grains of hydrogen sulfide per 100 cu. ft. and 3% carbon dioxide, is produced from the Smackover limestone formation at a depth of about 8700 ft. The sweet gas is produced from the Cotton Valley sand formation at about 8000 ft.

Sufficient pressure is held on the lease separators to bring the gas into the plant at a pressure of 590 lbs. per sq. in. This pressure is sufficient to pass the gas through the purification and absorption units and into the gas pipeline without compression.

Two 300 h.p. compressors have been installed. These compress low-pressure gas from oil wells in the fields to mix with the gases going to the hydrocarbon absorbers.

The sour gas, after metering, enters the absorbers of the Girbitol Process purification unit. A split gas stream enters two 5½ x 60 ft. absorbers packed with Raschig rings. The gas flows upward through an aqueous solution of monothanolamine, and after passing through a scrubber mixes with the incoming sweet gas going to the oil absorbers.

Purification Is Efficient

Monoethanolamine is an organic liquid having a specific gravity of 1.018 and a boiling point of 170.5° C. It has an alkaline reaction; as a base, it has about the same strength as ammonia. This one-stage purification unit is so efficient that the gas from the hydrogen sulfide contactors will pass the sensitive Bureau of Mines lead acetate test for hydrogen sulfide. The monoethanolamine solution flows from the contactors into a 10 x 65 ft. reactivator at 35 lb. per sq. in. where it is heated by two steam reboilers. Here the hydrogen sulfide and carbon dioxide are driven off and the amine solution is cooled and pumped back to the contactors where it is recirculated. At present the hydrogen sulfide is burned at a flare with other waste gases. The contactors operate at 90° F. and a pressure of 585 lb. per sq. in.

The combined gases enter the two 5 x 113 ft. absorbers through which a

*Chemist, Arkansas Fuel Oil Co.

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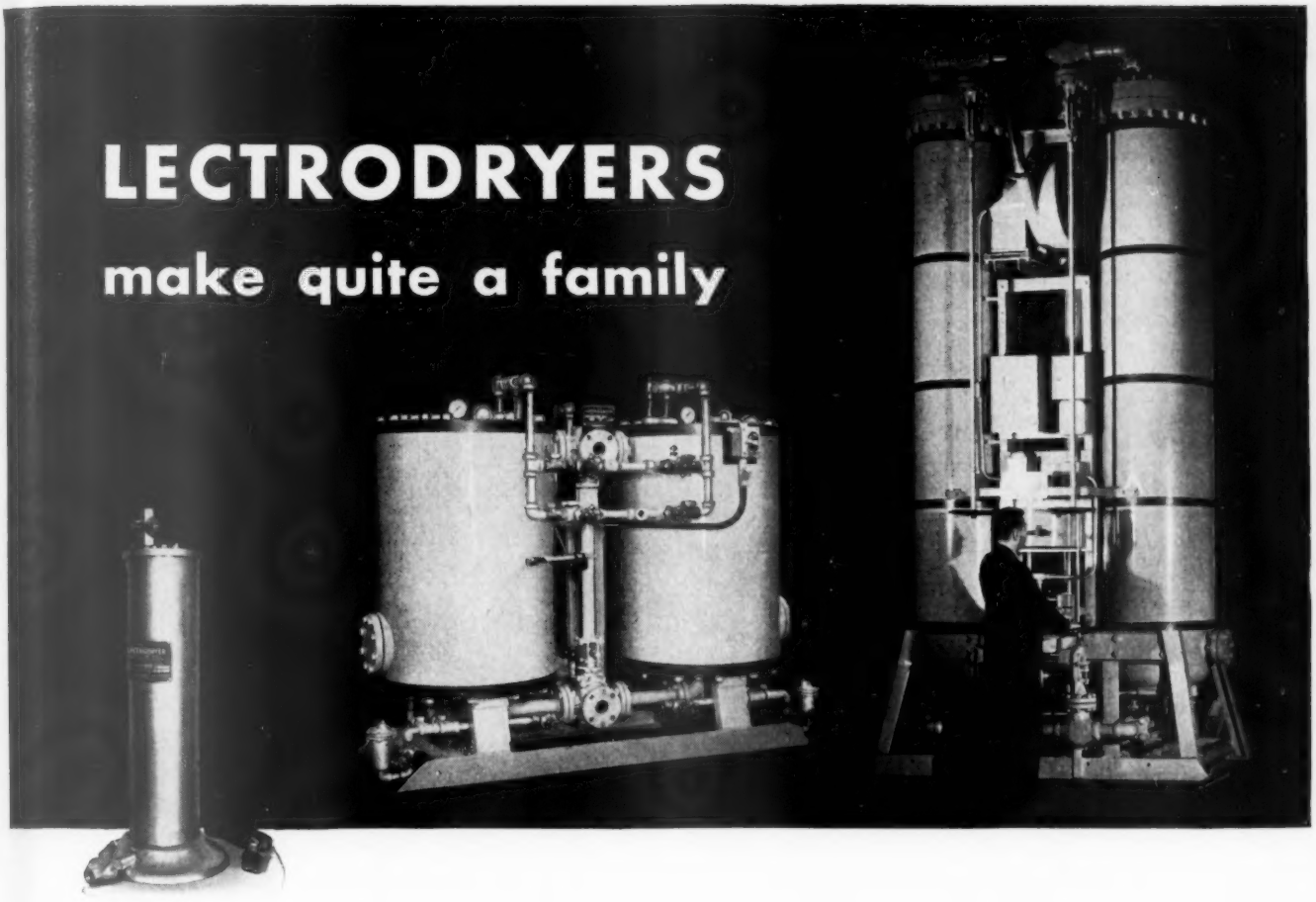

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narrow boiling range mineral seal oil is circulating. Each absorber, operating at 575 lb. per sq. in., is equipped with three intercoolers. The stripped gas passes through a dehydrating unit, is metered, and enters the gas transmission line of the Arkansas-Louisiana Gas Co. A solution of diethanolamine and diethlene glycol circulates through the dehydrator and is reactivated by heat in another tower in much the same way as the amine solution is circulated in the H_2S absorption cycle.

The rich oil from the absorbers goes to a high pressure reabsorber at 240 lb. per sq. in. and a low pressure reabsorber operating at 85 pounds before it enters a direct-fired Alcorn heater. Gas for plant fuel is flashed off in these reabsorbers. The oil leaves the heater at a temperature of 480° F. and enters a 6 x 59 ft. still under 100 lb. pressure. The lean oil from the bottom of the still is cooled and recirculated through the absorbers, while the raw feed for the fractionating equipment is taken overhead.

Hydrocarbons Separated

This raw feed enters the 3½ x 85 ft. depropanizer operating at 330 lb. pressure. This tower separates the hydrocarbons into a propane and lighter cut overhead and a butane and heavier product from the bottom. The overhead stream from the depropanizer is pumped to a de-ethanizer under 520 pounds pressure. A propane product is taken from the bottom of this tower while the overhead gas is flared.

The bottoms from the depropanizer enter the 3½ x 87 ft. debutanizer at 115-lb. pressure. Natural gasoline conforming to vapor pressure specifications is taken from the bottom of this tower while an iso- and normal butane mixture is the overhead cut.

The butane mixture enters the deisobutanizer which separates it into an iso-butane and an n-butane finished product. Because of the close fractionation required this tower is 4½ ft. in diameter by 145 ft. in height, and contains 70 trays of the usual bubble cap type. A pressure of 140 lb. per sq. in. is held on this tower.

All process pumps are grouped in one building. A modern instrument panel is placed in one section of this building for recording and controlling critical temperatures and pressures.

The propane, iso-butane and normal butane products from this fractionating equipment are all over 95% pure. The butanes and the natural gasoline are treated in a Perco solid reagent treater to remove traces of mercaptans present. The propane is given a caustic wash and moisture is removed in a calcium sulfate drier before going to storage.

Under full gas load the plant produces about 25,000 gallons of natural gasoline per day, 18,000 gallons of normal butane, 10,000 gallons of iso-butane and 9000 gallons of propane. The propane and butane are loaded in tank cars and trucks for liquefied petroleum gas sales. The iso-butane is loaded in tank cars while the gasoline moves by pipe line. The plant site is not on a railroad siding, so products moving by rail are pumped to a ten-car loading rack about two miles from the plant. Two 210,000-gal. Horton-spheroids are provided for gasoline storage, while 7500 bbl. of storage is available for the other products.

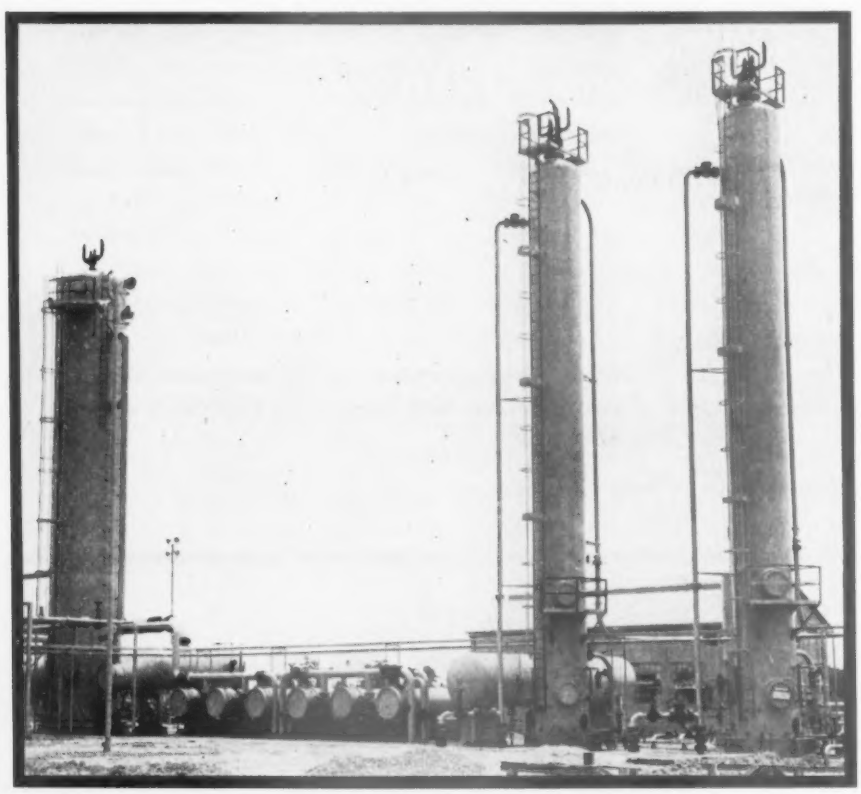
Three 600 h.p. B. & W. boilers furnish 250 lb. steam for plant use. All process pumps are steam operated. The boilers have a normal steam load of 90,000 lb. steam per hour. Boiler feed water is given an internal treatment of phosphates, sodium sulfite and an organic colloid by means of proportioning pumps. Continuous blowdown of the boilers is employed. A steam turbine driven generator furnishes electricity for the plant and for houses of employes. Three wells furnish water for boilers and for cooling water. A 1600-bbl. storage tank is used for boiler feed water while an elevated tank supplies drinking water for the plant and serves as water supply for the houses.

An atmospheric cooling tower comprising 50 bays is provided for cooling water for the plant. All reflux and final product coolers are of the atmospheric type, which are placed in the cooling tower. A portion of the tower is used for cooling water only. This water circulates through the absorber intercoolers, lean oil and amine coolers which are of the shell and tube type. A scale and corrosion inhibitor is continually added to the circulating water.

The laboratory is modern and well equipped. It is more complete than is usually found in gasoline plants. This is due partly to the control work necessary for the Girbitol process and to the close control of fractionating equipment necessary because of high purity requirements of the manufactured products. Facilities are available for complete testing of gasoline and liquefied petroleum gases, as well as for chemical analysis. A complete gas analysis laboratory is maintained for plant and field testing, equipped with a Podbielniak Hyd-Robot fractional analysis apparatus and other equipment necessary for complete analysis of gases.

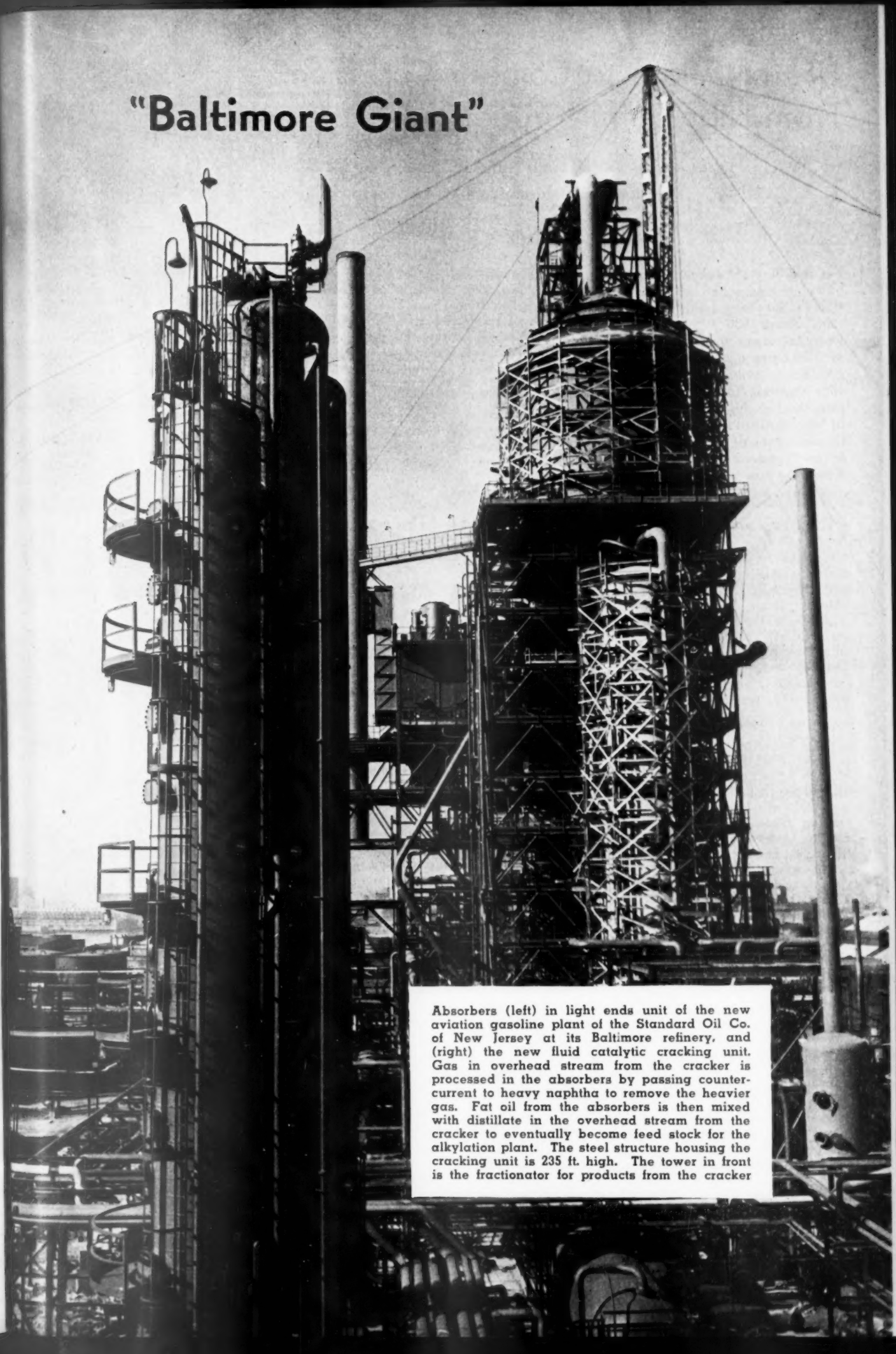
Daily analysis is made of circulating amine solution for amine content and both rich and lean amines are checked for H_2S content to determine the efficiency of the reactivation. A daily record is kept of the CO_2 and H_2S content of the inlet sour gas. The solution in the dehydrating towers must be checked so that losses in the system may be made up. Sufficient tests are made on products from the plant and in storage tanks to assure that specifications are met. Daily analyses are made on the boiler and cooling water to adjust the rate of blowdown and to determine the amount of chemicals to be fed to each system.

A continuous analyzer of the hydrogen sulfide content of the gas from the plant is to be installed. This device passes the gas through chemical solutions which are viewed by a photo-electric cell. The color difference is transferred to a recorder calibrated in grains of hydrogen sulfide per 100 cu. ft. of gas. An alarm will ring, giving notice to the operators, if the H_2S content reaches a predetermined point.



Left, reactivator and, right, two contactor towers of the Girbitol process unit for removal of hydrogen sulfide and carbon dioxide

"Baltimore Giant"



Absorbers (left) in light ends unit of the new aviation gasoline plant of the Standard Oil Co. of New Jersey at its Baltimore refinery, and (right) the new fluid catalytic cracking unit. Gas in overhead stream from the cracker is processed in the absorbers by passing countercurrent to heavy naphtha to remove the heavier gas. Fat oil from the absorbers is then mixed with distillate in the overhead stream from the cracker to eventually become feed stock for the alkylation plant. The steel structure housing the cracking unit is 235 ft. high. The tower in front is the fractionator for products from the cracker

Use of Alloys to Combat Corrosion From High Sulfur Crudes

Lining Vessels with Stainless Steel One Means of Offsetting Deterioration, International Nickel Research Authority Says

*By B. B. Morton**

Corrosion of refinery equipment handling high sulfur crudes is mainly from sulfur compounds at temperatures above 500 F., and from acid water at lower temperatures. Types of alloys are discussed to meet both conditions. Lining of existing vessels with stainless steel is a means for protection of this equipment. The use of bases such as ammonia and caustic to protect metal parts from corrosion at low temperatures should be governed by the material used in the condenser tubes.

CORROSION of refinery equipment is sharply divided. Above a certain temperature level, say 500° F., the attack is generally from sulfur compounds and chromium must be present to provide resistance. Below this level, the attack is of the electrolytic type when temperatures and pressures are such as to allow the presence of water in liquid form. Where liquid water exists, nonferrous alloys, such as Monel, brass, Admiralty, etc., are indicated.

Sulfur Corrosion

At elevated temperatures, taken here as above 500° F., sulfur tends to combine with steel to form a brittle sulfide. This sulfide is low in strength and often is rapidly removed, thus thinning and wasting the material. The actual thickness of steel removed in the scaling of the sulfide has been variously estimated. A value of one-third seems to fit the cases coming under the writer's observation. That is, one-third of the scale thickness represents the thickness of metal removed.

The vigor of sulfur attack increases with temperature and with partial pressure of the sulfur containing gases.

Chromium is the only commercially available element to give marked protection against sulfur. Fig. 1 shows the effects of increased chromium contents in decreasing sulfur attack. Table 1 gives the results of some tests and emphasizes the effects of chromium upon the rate of attack. Chromium not only provides protection against sulfur for iron, but it will also confer this protection upon nickel, an element quite subject to sulfur attack at elevated temperatures. A rough rule is that chromium will protect an equal per cent of nickel. This is well shown in the case of the alloy of 25% chromium, 20% nickel, which in actual service has demonstrated a resistance to sulfur of the same order as the 18% chromium, 8% nickel, alloys in which the chromium to nickel ratio is 2:1. As an exception to this rule, many valves trimmed with an alloy of approximately 18% nickel-8% chromium are used in high temperature service with excellent results. However, whenever possible, the chromium should equal or exceed the nickel contents if vigorous sulfur attack is expected.

Tubing for fired coils and hot transfer lines is subject to vigorous attack from sulfur compounds. The presence of chromium is urgently needed if a high order of resistance is required. The contents of chromium in the steel of the tubes should increase as the temperature increases; 2% chromium tubes, then 4-6% chromium tubes and, in some cases, 9% chromium or 18% chromium-8% nickel tubes are used in the hottest sections. A half to one and a half per cent of molybdenum is added to the chromium alloy steels to prevent temper brittleness.

The 18-8 tubes possess excellent resistance to sulfur, 40,000-60,000 hours and more being the expected life when high sulfur materials are handled. These alloy tubes have peculiarities of their own, and these should be understood before general usage is made. In general, the metal temperature must be held so as not to exceed 1200° F. Failures take place from the outside inward; hence, the tubes should be carefully inspected for outside cracks, often very fine.

Lining of high temperature reaction vessels with 12-14% chromium alloy, type 410 stainless, is preferred.

The art of lining existing vessels has been the subject of many papers (1, 2, 3)‡, K. E. Luger, metallurgical engineer of Carnegie-Illinois Steel Co., has offered the following among other important suggestions in regard to lining:

1. Strips shall be of low carbon type 410 (.08% C. Max., 11½-13% Cr) No. 1 finish, slit edge, cold rolled strip or No. 1 finish sheared sheet.

2. The width to be used shall be no greater than:

Maximum Operating Temperature	Width of Strip Inches
950° F. to 1000° F.	3
850° F. to 950° F.	3½
750° F. to 850° F.	4
Up to 750° F.	4½

3. Thickness of the stainless steel shall be .078 in. (the refinery may prefer to

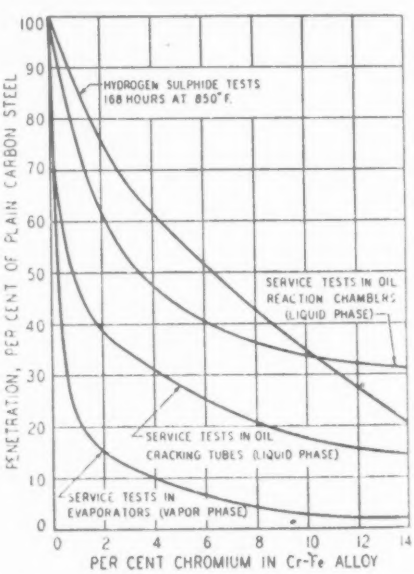

PENETRATION, PER CENT OF PLAIN CARBON STEEL
HYDROGEN SULPHIDE TESTS 168 HOURS AT 850° F.
SERVICE TESTS IN OIL REACTION CHAMBERS (LIQUID PHASE)
SERVICE TESTS IN OIL CRACKING TUBES (LIQUID PHASE)
SERVICE TESTS IN EVAPORATORS (VAPOR PHASE)
PER CENT CHROMIUM IN Cr-Fe ALLOY

Fig. 1—Effect of chromium on reducing corrosion on the various conditions of operation (From "Book of Stainless Steel," Second Edition, p. 240)

Table 1—Results of Tests on Corrosive Effect of High Sulfur Petroleum Products

Operation	Cracking	Fractionating	Fractionating
Location	Dephlegemator	Bubble Tower	Top of Bubble Tower
Temperature	760° F.	640° F.	250° F.
Petroleum Products	Gas Oil - Heavy Kansas Crude	Cracked Products West Texas Crude	Cracked Products West Texas Crude
	Penetration	**Penetration**	**Penetration**
Metals	In. Year	In. Year	In. Year
Steel (SAE 1020)	0.031	0.016	Destroyed
4-6 Cr Steel	0.010	———	———
18 Cr - 8 Ni	0.002	0.00007	Destroyed
Inconel (80 Ni-13 Cr)	0.002	———	———
Nickel	———	Destroyed	0.0057 Pitted
Monel (69 Ni-29 Cu)	———	———	0.0030 Pitted
Ni-Resist Cast Iron (15 Ni-6Cu-2 Cr)	0.017	0.013	0.051
Cast Iron	0.060	0.015	0.181

Note low temperature, moisture probably condensed.

*Development & Research Division, The International Nickel Co., Inc.

‡ Numbers refer to the bibliography at end of article.

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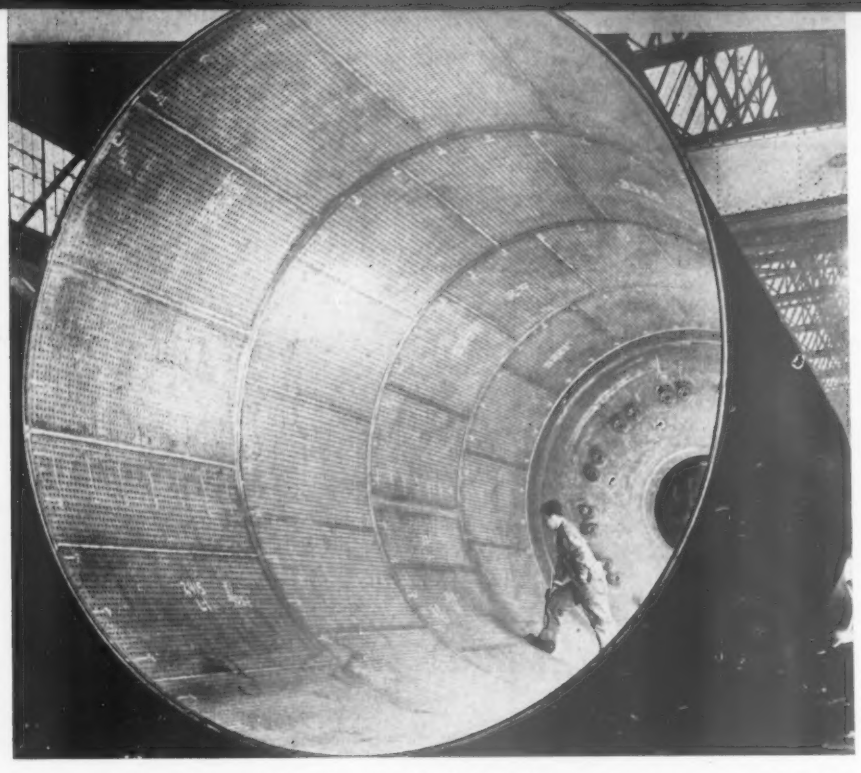

Fig. 2—Fractionating column lined with 18-8 stainless steel over large bottom section and with Monel in top smaller diameter section. Tower 125 ft. long (Courtesy A. O. Smith Corp.)

specify thicknesses of .109 in. or .093 in. rather than .078 in.).

4. The lengths of the strips shall be no longer than 30 in.

5. The weld rod shall be of 25 Cr—20 Ni of an approved manufacture. It shall be coated for arc welding and shall be ⅛ in. diameter.

Perhaps the ideal method of protection is to purchase new equipment made from steel faced with chromium alloys. Stainless clad steel and steel clad by the A. O. Smith method are widely used for vessels operating in the petroleum refineries and other industries.

Bubble towers offer a special case in lining. The greater part of the tower operates at a temperature level where sulfur attack is a factor. In the upper part, the reflux holds the temperature at a level where acid attack is a factor. The ideal setup seems to be to use a lining of 12-14% chromium alloy or 18-8 alloy with trays and caps of the same materials up to the top 4 to 6 trays. In this upper section, Monel lining and trays are suggested. Fig. 2 shows a tower so designed.

Pump parts are especially subject to attack due to turbulence and other factors. The 18% chromium-8% nickel alloy is highly satisfactory for pump parts of centrifugal pumps handling hot oil; 4-6% chromium steel with 0.50% molybdenum is widely used in reciprocrating pumps. A high chromium-high carbon alloy is used in the valves. An 18% chromium 1-1.50% carbon alloy is an example.

Valves of 4-6% chrome-0.50 Mo, with 18-8 or other high chrome trims and stems are suitable for high temperature service.

Heat exchanger tubes of 18% chromium-8% nickel are used where the high expansion of this alloy is provided for in the design. The shells are lined with 12-14% chrome alloy.

As far as the region of the equipment handling oil above 500° F. is concerned, it will be observed that the chromium alloys are indicated. The economics and engineering requirements and properties of the alloys will dictate the composition.

A special case of high temperature corrosion is where naphthenic acids are present in quantity, as during the refining of certain Venezuelan crudes. The attack from these organic acids is vigorous upon steel, chromium alloys and 18-8 The most resistant alloys so far uncovered are the 18% chromium-8% nickel alloys with 3% molybdenum, or Inconel, an alloy of approximately 80% nickel, 13% chromium. Both nickel and Monel made a good showing in resisting naphthenic acid, but the temperatures of operation were within the region (above 500° F.) where sulfur attack could be expected, so these materials were not considered for a certain practical application where Inconel was used.

As previously pointed out, corrosion within the temperature range where liquid water can exist is largely electrolytic in nature. The water is generally acid; hence, attack is often vigorous, especially if certain salts have been decomposed during operations at high temperature, and hydrochloric acid is formed.

Monel (approximately 2/3 nickel, 1/3 copper), brasses, Admiralty, and Ni-Resist cast iron (approximately 15-25% nickel, 0-6% copper, 2% chromium cast iron) are all widely used.

Often injudicious use is made of bases to protect metal parts. Ammonia and caustic are the two most commonly used. The error is often made, especially if using ammonia, of introducing it ahead of the condensers. If the body is of steel or cast iron, it is protected, but as the tubes are often of Admiralty, their life is enhanced and often shortened by this practice.

The more logical method is to line the shells with Monel and to introduce the base after the condensers. The material of the tubes is generally dictated by the water, which accounts for the widespread use of Admiralty.

Lining of the bottom half of the condenser shell is often resorted to, as the acid water generally appears as a result of the cooling effect of the condenser. In newer units, the shells are of welded monel construction.

Reflux lines in some instances are of Ni-Resist cast iron and excellent results have been reported. Where cast iron is not tolerated, lined steel piping is used, brass or Monel being the lining material. Concrete lined pipe has also been tried. The writer is not acquainted with the results.

Reflux pumps make use of Ni-Resist impellers and casings when handling corrosive material. For reciprocating pumps, K-Monel rods and Durable type valves of Monel have given excellent service.

Valves always occupy an important place in refineries. Brass, Monel, Ni-Resist, and other trims give good service in handling corrosive distillate. The valves are being widely displaced by cocks in much refinery low temperature service. Since metal-to-metal contact is often avoided in some of these cocks, corrosion is not as important an item as in the case of the valve. Where corrosion is not circumvented by design, the cocks are available in corrosion resistant materials as Ni-Resist and other alloyed cast materials.

Conclusion

In the foregoing, an attempt has been made to show that vigorous corrosion is to be expected when refining high sulfur crudes. The corrosion is increased in the high temperature region (taken above 500° F.) by the action of the sulfur and in the low temperature region as the result of a possibly more acid water condition.

Chromium is the element most efficient in conferring resistance to sulfur attack at high temperatures. The resistance increases with the chromium content up to about 20% chromium. The most marked increase takes place with the first 2%.

Nonferrous alloys, as Monel, brasses, and bronzes, are useful where the temperature conditions allow liquid water to exist. These alloys resist the corrosion under conditions where high chromium alloys are destroyed by the electrolytic attack.

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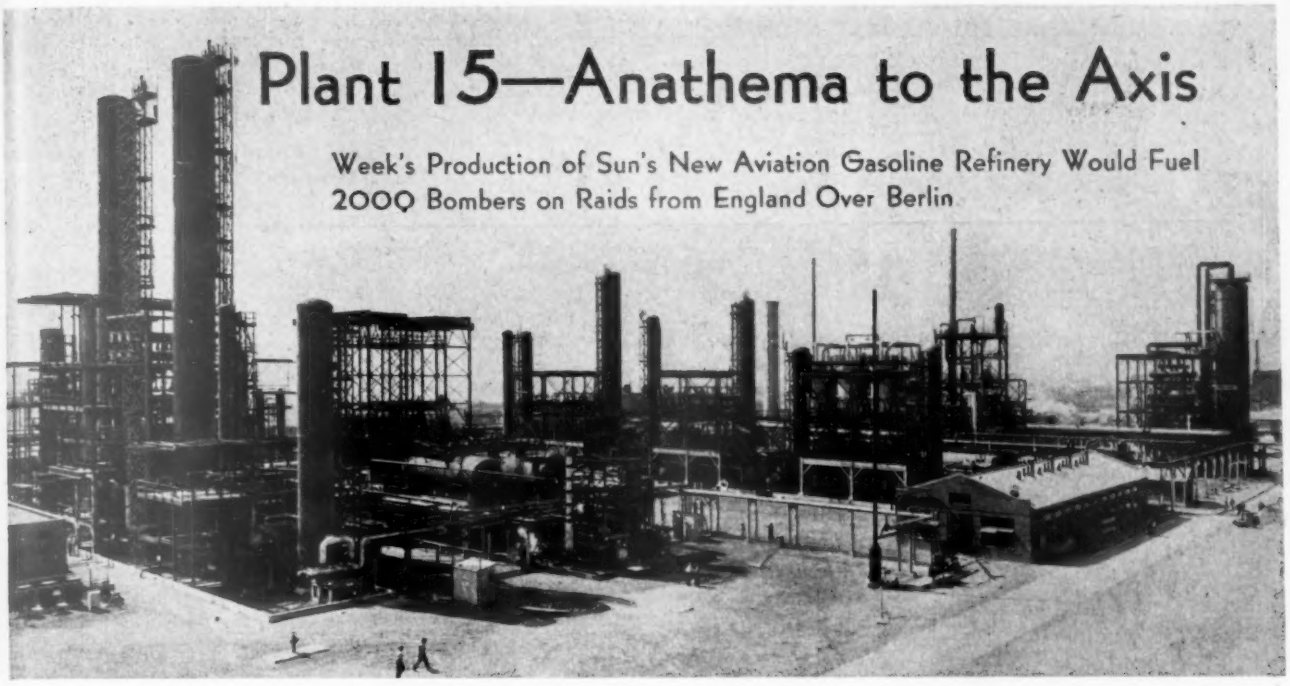
Plant 15—Anathema to the Axis

Week's Production of Sun's New Aviation Gasoline Refinery Would Fuel 2000 Bombers on Raids from England Over Berlin



A SIX-CASE Houdry cracking process unit, gas recovery and stabilization plant, and an anhydrous hydrofluoric acid alkylation unit comprise the essential features of the large 100-octane aviation gasoline plant of the Sun Oil Co. at Marcus Hook, Pa.

The $13,000,000 aviation gasoline plant, said to be the largest of its kind in the world, was financed entirely by the Sun company and is one of the first of the oil industry's new complete aviation gasoline refineries to be put into operation. It differs in many respects from other plants now under construction. It is typical, however, of the construction program of the oil companies generally, in that it utilizes their present processes, equipment, and raw materials in so far as possible, tying them together into a plant calling for a minimum of new construction but providing the maximum output of improved fighting fuels for the air fleets of this nation and its Allies.

Large as it is, Plant 15, as the new aviation gasoline manufacturing facilities of Sun Oil Co. are known in the Sun family of executives and operators, occupies only a small part of the Marcus Hook refinery. Raw materials are supplied to it not only from other parts of this refinery but also from another distant refinery of the Sun Oil Co. Actual capacity cannot be divulged, but it can be said that enough 100-octane-plus gasoline is produced each week to drive more than 2000 four-motored bombers on raids from England over Berlin. Moreover, additional construction is now in progress to increase its present facilities.

Charging stock for the plant consists of cracked gases from cracking operations at the Marcus Hook refinery and cracked aviation base naphtha from all operations at Marcus Hook and also from the company's refinery at Toledo, O. The Houdry unit in connection with Plant 15 functions as a reprocessing or treating unit rather than a primary cracker; the gases produced as a byproduct from this operation, plus those from the balance of the refinery, give more than enough raw material for alkylate production and isopentane for blending. Excess isopentane may be sold to other 100-octane plants for blending purposes, or used in Sun's own blending.

The Houdry Unit

The raw aviation naphtha, after stabilization, is charged to the battery of 6 Houdry cases after first being preheated to the desired temperature. As operations are vapor-phase, this temperature is sufficiently high to assure complete vaporization, probably about 850°F. and under enough pressure to keep volume of gases handled to a minimum but yet low enough to avoid possibility of condensation. The processing of the already cracked aviation base naphtha results in an increase in concentration of the desired compounds in the finished aviation gasoline, as well as increased yields. The content of aromatics is said to be higher and usually there is a slight increase in the amount of isopentane, thus providing greater volatility. Impurities also are almost completely removed in the reprocessing, and the resulting increase in quality lowers the quantity of alkylate required for blending to produce the finished aviation gasoline.

Synthetic Catalyst Used

For the treating of the already cracked base stock the same catalyst is used as if the charge were gas oil, reduced crude, or tar bottoms, as in primary cracking operations of the Houdry units. Each Houdry catalyst case contains nearly 20 tons of catalyst, and about 120 tons of catalyst are involved in the complete operations of the 6 cases of the Houdry unit. The catalyst now being used is the latest to be developed by Eugene Houdry, inventor of the Houdry process, and his assistants. The first catalyst was a refined clay, for the most part composed of natural aluminum silicates. The catalyst in use today, tailor-made for every plant and, indeed, even for individual cases of a unit if necessary, is a synthetic combination of aluminum and silica with other not disclosed ingredients which, together with the "know-how" of manufacture, greatly excels the original catalyst in activity, stability, and selectivity.

Following the usual cycle of Houdry operation, two of these cases always are on-stream, two others are undergoing the regeneration which consists of removing coke deposited on the catalyst during cracking, while the other two are undergoing purging and repressuring in preparation for a new cycle. There are 9 valves to be operated on each case during the cycle of operations; and there are about 48 cycles a day on each case. The sequence of valve manipulation is entirely controlled by an automatic cycle-timer which assures freedom from accidents resulting from possible non-coordination in manual operations.

The control room is the nerve-center of the Houdry unit. Here gauges and recorders show temperature, pressure, flows of oil and vapors in all parts. The panel board has at its center the cycle timer which operates the valves keeping oil passing continuously through certain cases and air continuously passing through others for regeneration, with the necessary purging intervals between. The lights on this board show which of the motor operated valves are open (red) or closed (green), indicating exactly what is going on in each of the cases. The lights of a single case may be watched, showing the case with oil going through, the closing of the oil-in and oil-out valves, and the evacuation of the remaining oil vapor from the case. Air-in and air-out valves automatically open and regenera-

Two 150-ft. deisobutanizing towers in the alkylation unit of the Sun Oil Co. aviation gasoline plant

tion proceeds. Then the air valves are closed. After evacuation of the air, the case returns to the on-stream period which completes the cycle.

Hot Gases Returned

To burn off the 64 tons daily of coke deposited on the catalyst in each case during the cracking reaction, 40,000 cu ft per minute of air is required; this is supplied by giant turbo-blowers. The hot gases from coke combustion are returned to the turbine-side of the blowers, where they are utilized in supplying the motive power for the blowers. While at first thought this sounds like perpetual motion, actually it is not. The air, in supplying oxygen for coke combustion, is itself heated in the process, while additional volumes of gas are produced during the burning. This heat and additional gas volume furnishes the real motive power for the blowers, and the excess drives turbo-electric generators to make some electric power. Additional heat produced in the catalyst revivification, absorbed by the molten salt coolant, makes 60,000 lb of superheated steam per hour delivered to services at 450 lb per sq in. pressure.

Vapors from the re-cracking or treating of the aviation base naphtha, in the main gasoline and light gases, are passed to a fractionator where the gasoline is separated and stabilized and sent to the blending unit of the aviation gasoline plant. The light gases themselves are separated.

Charge to the gas recovery and stabilization plant consists of the catalytically cracked, aviation base naphtha produced at the Marcus Hook and Toledo refineries plus gases formed in cracking operations throughout the Marcus Hook refinery. The cracked naphtha is stabilized to specifications before processing in the Houdry unit.

In the initial fractionating, the cracked naphtha or gasoline is freed of C_2 and lighter gases—methane, ethane, and ethylene—in the overhead, which is utilized for fuel in the refinery. Then propane and other C_3 are removed and sold either as liquefied petroleum gas or for use in chemical plants as raw material. Following depropanization, the charge is debutanized, and this is further separated in another fractionation to recover normal butane and butylene, the so-called "B-B" cut, for manufacture into alkylate.

Isopentane recovered in the next step is segregated and used in blending the final aviation grade gasoline to specifications; any excess is sold to other aviation gasoline manufacturers for the same purpose. All these gases except C_2 and lighter receive a caustic wash for sulfur removal.

The final step removes C_6 and C_7 hydrocarbons, which contain most of the residual sulfur compounds remaining in the base charge stock.

Refinery gases go through the same process, simultaneously with the cracked gasoline. Bottoms from the final separation constitute the charge to the Houdry catalytic treating section, previously described.

AHF Alkylation Plant

The function of the alkylation plant, using anhydrous hydrofluoric acid as catalyst, is to combine isobutane with butylene to form one of the family of octanes. The final product is, of course, not a single pure compound; rather, it is a mixture of several of the octanes, the most predominant compound in the mixture being the one most sought, 2, 2, 4 trimethylpentane. This material has a very high octane rating in its own right, as well as being high in tetraethyl lead susceptibility.

A temperature in the neighborhood of 100°F. is considered optimum for alkylating butane and butylene in liquid phase. The pressure on these light gases is sufficient to assure that they, as well as the anhydrous hydrofluoric acid catalyst, remain in liquid phase. The butane-butylene feed enters at the bottom of the contactors, where it is intimately mixed with the catalyst which enters from the top. The six contactors of the unit recirculate the mixture of feed, catalyst, and alkylate at the rate of 300,000 gal per minute.

As the alkylation reaction is exothermic, 16,800 gal of water per minute are circulated through tubes in the upper part of the contactors. Rate of feed, catalyst acid, and effluent are sufficient to permit high conversion to the desired product. The reason that catalyst acid is not mixed with the feed is because polymerization of the butylene would occur. Although not done in Sun's plant, it is feasible to mix the catalyst acid with the butane, charging the olefin separately. High rate of agitation is necessary in any case to avoid polymerization.

After passing through the contactors, the fluids are charged to a settler where most of the hydrogen fluoride disengages itself from the reaction mixture, to be returned to the contactors or to go first to the acid regeneration plant and thence to the contactors. The mixture of alkylate and unreacted butane, plus a slight amount of dissolved AHF, then is charged to two fractionation towers. These two towers are a noteworthy feature of the entire unit; they are each 150 ft. high and so large that they require enormous quantities of cooling water to be brought to the plant in a 3-ft. main.

In the fractionator towers, the alkylate is freed of unreacted butane as well as the slight quantity of AHF held in solution. The unreacted isobutane is returned to the contactors as part of the feed while the acid is sent to the regeneration plant. The alkylate thus purified is ready for blending without further treatment.

100-Octane Plus Aviation Gasoline

The final product of the new Sun Oil Co. plant, 100-octane-plus aviation gasoline, is a combination or blend of aviation gasoline base naphtha, isopentane for volatility and high tetraethyl lead susceptibility, alkylate, and a small quantity of tetraethyl lead. Aviation gasoline, unlike the common conception, cannot be adequately described simply by designating its octane rating. True, it must not "knock" in use. Its knocking characteristic is tested in a knock engine in comparison with pure iso-octane which has a defined octane rating of 100, so it is designated as "100 octane," although its actual antiknock qualities may be superior to those of 100-octane. However, the economy of the fuel in use and the power it develops must also be described to designate it properly. Today, these other "plus" characteristics cannot be disclosed for reasons of military security. It may only be said that the fighting grade aviation gasoline of today is definitely better than the grade of a year ago.

The methods used by Sun Oil Co. for the production of aviation gasoline in the new Marcus Hook plant are not the only way it can be produced. Other cracking processes are being utilized to produce the base gasolines, and other types of blending materials are used. Some straight-run gasolines produced from selected grades of crude need relatively little blending with tetraethyl lead, alkylate, and isopentane to meet military requirements. Many small plants, too small to make it economically feasible to construct complete aviation gasoline manufacturing facilities, are helping to their utmost by producing isopentane, butane, butylene, cumene, and codimer from their refinery gases as blending agents. Some others are producing thermally-cracked and straight-run gasolines which are shipped to other manufacturers for final processing and blending.

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Asphaltization Tests for Lubricating Oil

Simple and Inexpensive Method Devised for Sampling Potential Diesel Lubricants to Determine Possible Loss of Fluidity

By J. Faust*

Under certain conditions of oxidation some lubricating oils were found to lose their fluidity and turn into asphalt-like material. The asphaltization rate is affected by various metals and alloys. This behavior in an oil is believed similar to that of an oil in a Diesel engine leading to ring sticking and other conditions. A standardized test procedure is presented for differentiating oils by their susceptibility to asphaltization and for correlating this tendency with other characteristics of a lubricant. It is believed that the procedure permits the prediction of the behavior of an oil in a Diesel engine.

In the course of a study of oxidation characteristics of lubricating oi's we have observed that when certain lubricating oils are subjected to intensive oxidation under certain conditions they tend to lose their fluidity and ultimately become converted to a solid, asphalt-like material. The time required for such transition, which we call asphaltization, varies with the type of oil, and on the basis of observations of the behavior of a wide selection of lubricating oils when subjected to oxidizing conditions designed to produce asphaltization, we have been able to establish two categories of oils from the standpoint of their susceptibility to this phenomenon, viz:

1) *Rapidly asphaltizing lube oils*: In this category are the conventional Pennsylvania oi's, represented by blends of bright stock (residual oils) with neutrals (overhead distillates). Such blends exhibit a drastic increase in viscosity and tend to form oil soluble sludge when subjected to the oxidizing conditions obtained throughout the asphaltization cycle.

2) *Non-asphaltizing lubes*: In this category are the overhead distillates and some of the Midcontinent oils. These retain their fluidity but tend to form an oil-insoluble, hard granular sludge.

The mechanism by which the concomitant formation of these two types of sludges results in the ultimate asphaltization of oi's in which they are generated by oxidative conditions is as follows:

In lubricating oil blends of bright stock and neutrals, the oil soluble sludge, which is formed from the bright stock, "glues" or cements together the hard carbonaceous sludge formed from the neutral, thereby preventing it from precipitating out of the oil. It is the "cementized" composite sludge which is the factor which is primarily responsible for asphaltization. Furthermore, this mechanism is accelerated by the presence of metallic soaps, whether introduced *a priori*, possibly as an additive, or formed *in situ* as a result of the action of the acidic products of oxidation of the oil upon the metallic surfaces typical of modern bearing metals and al'oys. That the extent of this acceleration varies with the type of metal present will also be seen later in this paper.

Striking corroboration of this theory of asphaltization is found in the explanations advanced by Treiber[1], Rosen[2,3] and others [4,5] on the causes of piston ring sticking in Diesel oils. For it is precisely the paral'elism of the behavior of an oil in a Diesel engine to its behavior under the conditions which lead to asphaltization under intense oxidative conditions that reflects the validity of our concept of aspha'tization and the value of the test which we have developed for measuring this tendency.

O. D. Treiber[1] has pointed out that: "The fuel is injected into a Diesel engine at a pressure and temperature well above the cracking range. This produces an abundance of free, colloidal carbon . . . . This carbon will not stick together any more than a quantity of sand. It requires a binder or some 'cement' to become a factor in sticking any parts together. The cement can also come from lubricating oil and the Diesel engine forms more of this cement from lubricating oil than gasoline engines due to higher compression temperature and the unquestionably high blow-by."

H. Rosen[2] cites the fact that: "The blow-by gases in a Diesel engine are over 90% pure air and, therefore, provide one of the best oxidizing apparatus available" for a lubricant.

The object of this paper is to present a standardized procedure designed to induce the asphaltization of lubricating oil and to provide a numerical basis for differentiating lubricating oils from the standpoint of their susceptibility to aspha'tization. As will be seen further, the procedure is adequate for establishing the correlation between tendency to asphaltization and other, more familiar, characteristics such as color, viscosity, etc. It is our opinion that the procedure permits the prediction of the behavior of an oil under the oxidizing conditions prevailing in the Diesel engine itself.

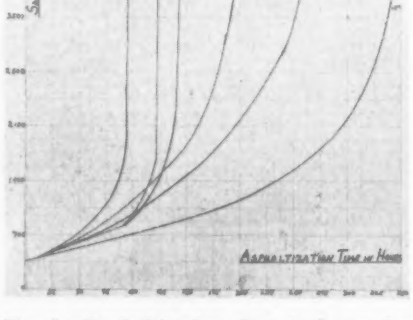

Fig. 1—Asphaltization time in hours for a conventional Pennsylvania SAE 20 oil, plotted against per cent viscosity increase

Operating Conditions of the Asphaltization Test

The asphaltization test is carried out conveniently in the standard Indiana Oxidation Apparatus, modified only by the introduction of metals; the temperature of the apparatus and the f'ow of air passing through it are maintained at respectively 341°F and 10 liters per hour.

The presence of the metals is resorted to, as is already mentioned, for their accelerating action. However, we have found that not all metals accelerate asphaltization to the same degree.

The difference in the accelerating action of various metals and al'oys (singly and in combination with metals) may be seen from Fig. 1, in which the asphaltization time in hours of a conventional Pennsylvania SAE 20 oil was plotted against per cent viscosity increase. Steel or iron, for example, hardly affected the asphaltization rate of the oil; copper, however, was found to acc'erate the asphaltization of the oil to a considerable degree. CuPb, CdAg and combinations of CdAg with Cu or with CuPb were found to have a still greater accelerating effect, cutting down the asphaltization time of the oil to a very considerable degree. This is illustrated by Table I.

For the standardized laboratory asphaltization test, CdAg (cadmium silver) bearings were found to give the most satisfactory resu'ts as regards accuracy and reproducibility. The CdAg bearings used are of the type used in commercial automotive engines, since our

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Table I—Asphaltization Time in Hours for a Conventional Pennsylvania Motor Oil SAE 20

	Hours
Blank sample (no metals)	360
Same oil (metals present):	
Steel	350
Cu	260
CuPb	210
CdAg	140
Cu plus CdAg	120
CuPb plus CdAg	96

object was also to conduct the test under conditions closely approximating actual conditions of service.

Evaluation of Asphaltization Tendency of Lubricating Oils

Viscosity increase was found to be the best criterion for following the changes and overall deterioration any oil undergoes when subjected to the asphaltization test. Other methods, such as, Naphtha Insolub'e determinations, Acid Numbers, Saponification Numbers, Carbon Test, Ash Content, Spot Test and Loss of Weight due to corrosion were found unsuitable for evaluation of asphaltization.

Naphtha Insoluble determinations, for example, gave misleading results, because the sludge yielded by rapidly asphaltizing oi's was difficult to filter and the values obtained for the Naphtha Insoluble sludges were small and insignificant. The measurement of loss of weight of the metallic bearings due to corrosion yielded somewhat better results but was found unreliab'e, since the metallic bearings were often completely denuded of their alloy layer long before the oil was asphaltized.

The correlation of increase of viscosity (i.e., loss of fluidity) of the oil and asphaltization tendency is illustrated by the data given in Table II, in which the viscosities are given as Saybolt seconds at 80°F.

The results in Table II as plotted in Fig. 2 show that the critical point at which the oil acquires a sudden, extraordinary increase in viscosity occurs after about 120 hours. The oil at this point, while gel-like, still possesses some mobility; after 140 hours mobility is nearly gone; and it then changes to a semi-solid, plastic asphalt. The time at which the oil barely moves is recorded as the Asphaltization Time in hours or the Asphaltization Index of the oil.

Viscosity can also be determined in the Saybolt Viscosimeter at 210°F; for routine purposes, however, it is sufficient to examine the fluidity of the oil at definite interva's of time, as will be described below.

Table II

Correlation of Increase in Viscosity and Asphaltization Tendency (Seconds Saybolt viscosity at 80°F. of an SAE 20 Pennsylvania oil tested with CdAg bearings)

Time of Test Hours:	Viscosity Seconds:
24	565
48	675
72	1050
96	1900
120	4550
140	barely moving
168	solid

Procedure:

400 cc of the oil is introduced into a standard I.O.T. tube and a section of standard CdAg bearing (Part No. 19-229) about 1½ in. wide and 3 in. long is suspended in the oil, on an iron or steel wire. These bearing sections should be cleaned preferably with a rubber eraser and not with emery paper since scratches or any mechanical damages to the surface were found to affect the reproducibility of results. The steel back of the bearing, however, may be cleaned with emery paper.

When the oil has reached a temperature of 341°F., air is b'own through it at a rate of 10 liters per hour. Maintenance of a constant temperature and air supply is, of course, essential in assuring accuracy of results. At definite intervals a small sample of the oil is taken out (about 5 cc) and transferred into a regular test tube. When the oil has cooled to room temperature, the test tube is placed into a water bath maintained at 80°F. and after about 15 minutes is taken out and tested for fluidity by turning the test tube upside down. If the oil is still fluid, the test is continued. When the oil is barely moving, the test is continued for another 8 or 16 hours and then tested again. When the oil is found non-fluid, the test is discontinued.

The results obtained with two Pennsylvania oils—one (Oil No. 1) a conventional'y refined, the other (Oil No. 2) a specially refined oil which has the Caterpillar approval—are given in Table III. To show the reproducibility of the asphaltization test, both oils were run in quadruplicate.

The data in Table III show that the resu'ts of the Asphaltization Test check within 6%. At the same time they point to the correlation between the results obtained in the Asphaltization Test and the Caterpillar Diesel Engine Test. Since the oil which passed satisfactorily the Caterpillar Test had an A.I. of about 345 hours, it appeared reasonable to establish the Asphaltization Test for a maximum period of 400 hours.

Factors Influencing The Asphaltization of Lubricating Oils

An attempt has been made to correlate the asphaltization tendency of lubricants with some of their characteristics, such as type, composition, physical properties, manufacturing methods, additives

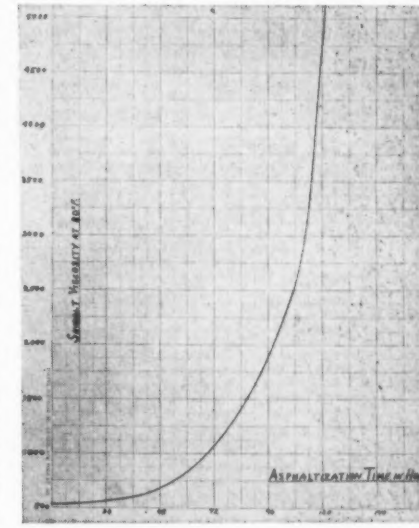

Fig. 2—Asphaltization time in hours correlated with Saybolt viscosity at 80F. of SAE 20 Pennsylvania tested with CdAg bearings

present, etc. Of interest was first to investigate the effect of initial viscosity of the A.I. of lubricating oils.

1. *Effect of Initial Viscosity*: Preliminary tests conducted with a series of conventional Pennsylvania oils, varying in viscosity from SAE 10 to SAE 70 have shown that the asphaltization tendency of a lubricant varies with its initial viscosity. A series of oils from SAE 10 to SAE 70 was prepared by b'ending a 180 viscosity Pennsylvania neutral and bright stock.

These oils were then subjected to the Asphaltization Test and the results obtained are given in Table IV. Note: Included in same table are the ratios in which these oils were blended and the Saybolt viscosities of these blends at 210°F.

The results in Table IV indicate that initial viscosity is definitely related to the asphaltizing tendency and that the higher the viscosity, the higher (the better) the Asphaltization Index of the oil. The A.I. appears to reach its maximum with an SAE 40, remaining practically constant with higher viscosity oils.

A striking exception, of course, is SAE 10, its asphaltization time being over 400 hours. This is because this oil is an overhead distillate, which, as stated in the introduction, forms only a granular, precipitable sludge not so greatly affecting the viscosity of the oil. The other oils, however, which are composed of overhead distillate and residual oils, form both types of sludges, the granular and glue-like, the latter cementizing the former and remaining in solution in

Table III—Asphaltization Index in Hours (Tests run in Quadruplicate)

	a	b	c	d	Avg.
Oil No. 1	120	128	128	120	124
Oil No. 2	340	348	348	350	346.5

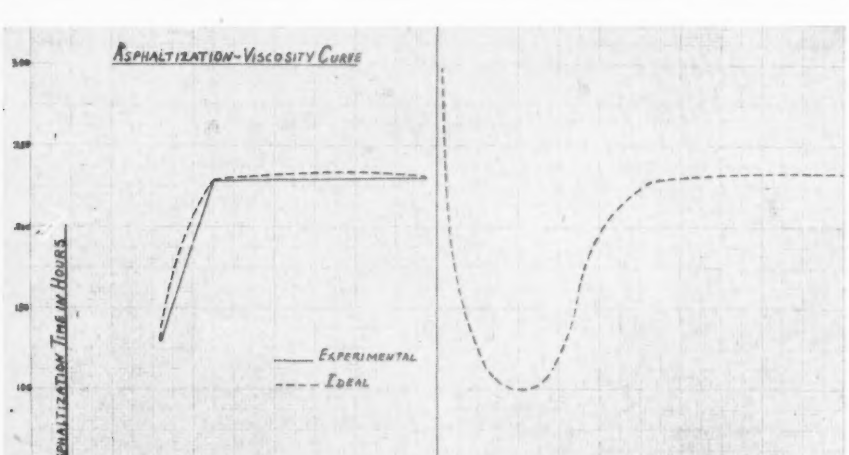

Fig. 3—Curves of ratio of bright stock in oil to asphaltization index

the oil. This "cementizing" combination of both types of sludges remaining in the oil causes the solidification of the oil. The worst possible conditions for this phenomenon exist in an SAE 20 oil and is evidenced by its lowest A.I. The results obtained are shown in Fig. 3 by the curve on the left side. This curve is obtained by plotting the ratio of bright stock used in preparing the various SAE grades against the Asphaltization Indices in hours.

Note: The curve on the right side of Fig. 2 refers to an ideal curve which we would presumably obtain were all possible combinations of bright stock and neutral tried out in a ratio from 99 neutral to 1 bright stock up to a ratio of 1 part neutral to 99 parts bright stock.

2. *Effect of Color*:

This study was carried out on a series of samples of a basic Pennsylvania Diesel oil stock filtered to different colors ranging from 1R to 6.5R (Lovibond colorimeter ½ in. cell). The specification properties of these oils together with Asphaltization Indices are given in Table V.

The results shown in Table V seem to indicate that the color has some influence on the A.I. of the oil. There is, however, a "critical point" corresponding to a certain color—in this particular case apparently 4R—at which the optimum A.I. is obtained. The reason for this may be that the filtration to which oils are subjected as their final refining step removes two types of compounds, both most probably of aromatic character; one which acts as a natural asphaltization inhibitor, and the other as natural asphaltization accelerator. As long as the first predominate, which is possibly the case when the oil is overfiltered or when the filter material is exhausted, the A.I. is low. When, however, the natural inhibitors predominate, the A.I. improves. More research seems necessary to corroborate this assumption.

3. *Effect of Manufacturing Methods*:

From the data obtained in the course of this investigation, it is not unreasonable to conclude that any process tending to remove a certain type of hydrocarbons from a Pennsylvania Diesel oil stock will produce an oil of high A.I. Thus, solvent extraction or acid treatment would seem feasible as methods of producing a non-asphaltizing HD oil; the latter, for example, yielded the following results with two acid treated cylinder oils blended with 180 neutral to an SAE 20 viscosity oil. The ratio in which these oils were blended, together with their specification properties and A.I.'s, are given in Table VI. A conventionally refined Pennsylvania basic HD of SAE 20 is included for comparison:

The data in Table VI suggest that acid treatment has a beneficial effect on the A.I. of lubricants as evidenced by the higher A.I. of samples A and B.

Non-Asphaltizing Oils

The term "non-asphaltizing oils" is to be construed in a relative sense only, as a designation for oils found to withstand the operating conditions of the asphaltization test for more than 400 hours. The period of 400 hours was adopted as the limit because subjecting the oil to longer periods of catalytic oxidation would deteriorate it beyond the point of any practical consideration.

In this class we find two types of oils, one in which the high A.I. is due to the presence of an inhibitor, the other in which the A.I. is attributable to type or composition. However, not all oils belonging in the class of "inhibited oils" show the same behavior. (In view of this observation, a detailed study of the influence of various additives on rate of asphaltization would seem to be in order.) Examination after 400 hours disclosed that Pennsylvania oils (representing blends of residuals and neutrals) show only very little precipitable sludge, while Midcontinent oils give tremendous amounts of a hard, carbonaceous sludge. In fact, more than half of the latter were found to have deposited a hard, carbonized mass after 400 hours, though the supernatant oil remained per-

Table IV—Effect of Initial Viscosity on Asphaltizing Tendency

% 180N	% Bright Stock	SAE No.	Saybolt Vis. at 210°F. of blend Seconds	A.I.* of blend Hours
100		10	48	more than 400
68	32	20	58	128
60	40	30	64	180
55	45	40	75	224
33	67	50	86	228
12	88	60	118	228
5	95	70	136	230

*Asphaltization Index

Table V—Influence of Color on A.I. of an SAE 20 Pennsylvania Diesel Oil Stock

Color (Lovibond ½-in. cell)	1R	2R	3R	4R	5R	6.5R
Specific Gravity	31.2	30.8	30.0	29.5	29.3	29.0
Say. Vis. at 100°F.	302	322	342	361	366	372
Say. Vis. at 210°F.	55	56	57	58	58.5	58.5
Flash °F.	425	425	425	425	425	425
Fire °F.	475	475	475	475	475	475
Pour Point °F.	+35	+55	+35	+35	+35	+35
Carbon Test %	0.15	0.2	0.29	0.34	0.38	0.47
Viscosity Index	114	112	111	110	110	109
Asphaltization Index-Hrs.	168	168	180	336	172	192

Table VI—Effect of Acid Treatment on Asphaltization Index

Samples	A 34% 122 Vis. Acid Treated Cylinder Oil plus 66% 180 Neutral	B 30% 150/155 Vis. Acid-Treated Cylinder Oil +70% 180 Neutral	C Conventional Pa. basic Hd of SAE 20
Specific Gravity	28.1	28.3	29.3
Vis. Say. @ 210°F., secs.	58	58	58.5
Flash °F.	440	445	425
Fire °F.	495	495	475
Color	5R	5R	5R
Asphaltization Index	336	336	172

fectly fluid, a similar behavior to that which was observed with a Pennsylvania overhead distillate. These oils formed excessive amounts of hard carbonaceous sludge already in the first stages of the test, which increased steadily in amount as the Asphaltization Test progressed.

The best way to differentiate generally between the so-called "non-asphaltizing oils" is to determine their Petroleum Ether Insoluble or still better, to determine their viscosity at 210°F. after completion of the 400 hour Asphaltization Test. This is illustrated in Table VII, which shows the differences in viscosity increases of two typical, non-asphaltizing oils; one, Oil No. 6, a straight Pennsylvania neutral, the other, oil No. 7, a Midcontinent solvent treated oil.

The reproducibility of the results obtained is demonstrated in testing another Pennsylvania 180N oil in duplicate, in Table VIII.

Table VII—Differences in Viscosity Increases of Two Typical Nonasphaltizing Oils

	Saybolt Viscosity at 210°F. Before Testing	After 400 hrs. A.T.	% Viscosity Increase
Oil			
Oil No. 6	48 secs.	278 secs.	480
Oil No. 7	55 secs.	188 secs.	240

Table VIII—Reproducibility of Results

	Saybolt Viscosity at 210°F. Before Testing	After Testing	% Viscosity Increase
Oil			
Sample a	48 secs.	282 secs.	234
Sample b	48 secs.	274 secs.	226

Summary and Conclusion

Lubricating oils were found to lose their fluidity and turn into an asphalt-like material under certain conditions of oxidation. A study of the conditions under which this phenomenon occurs has led to the development of a simple, reproducible and inexpensive test which can be utilized for testing samples of potential Diesel Oils. The asphaltization tendency of lubricating oils is evaluated by measurment of increase in viscosity of the oil, i.e., loss of fluidity of the oil. The time required to convert a lubricating oil under the operating conditions of the Asphaltization Test into a gel-like, barely mobile mass is called the Asphaltization Time or Asphaltization Index and is expressed in hours.

Several factors which influence the asphaltization tendency of oils have been investigated. It was established that it is the residual oil hydrocarbons which cause the formation of the cementizing sludge leading to asphaltization of a lubricant.

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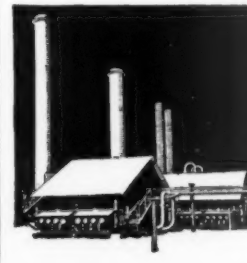
History does not record the discovery of fire, but from the fragmentary story of origins, we learn that civilization began only when primitive man learned to kindle flame. From this costly and precarious luxury, subjugated by ages of weary and uncertain experiment, has come every boon known to mankind. One of the most important benefits of fire is its application for heat in petroleum processing. Pioneering 20 years ago in engineering heaters for hydrocarbons, Alcorn installations in world-important refineries are achieving new peaks in efficiency. Well abreast of the ever changing technique of the industry, Alcorn merits your consultations for the solution of any heating problem.



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Wide Variety of Compounds Studied As Additives for Diesel Fuels

A GROWING list of patents covering improvements in ignition qualities of Diesel fuel is evidence of research investigations in this field being carried on by the petroleum industry and chemicals manufacturers. The need for keeping up both quality and quantity of fuel for high-speed Diesel engines, despite the conflicting requirements of high-octane aircraft fuel manufacture has been discussed at length in an earlier article[1]. Approximately 100 U. S. patents already have been issued for addition agents for Diesel fuels to improve cetane number; numerous patents have been issued by foreign governments also. (*See bibliography.*)

Four patents on additives for Diesel fuels held by the Atlantic Refining Co. cover straight-chain aliphatic ethers, olefinic nitrosates and/or nitrosites, and alkyl and some aryl borenes. This company did considerable research on Diesel fuel additives several years ago which resulted in the patents it now holds.

A company spokesman stated recently[2] that from a survey of cetane number requirements for Diesel engines, the opinion was held that 40 cetane number is satisfactory for most of present day Diesels and that 45 cetane will take care of most of the remainder. As Diesel fuels marketed by most oil companies are 50 cetane number or higher, Atlantic Refining Co., for the past few years has felt that extensive research on additives for further improvement of cetane was not justified. However, under present conditions the company does contemplate research investigations on Diesel fuels produced by catalytic cracking.

Cetane Numbers Listed

In partial agreement with the above statement, Bogen[3] lists the cetane numbers of straight-run Diesel fuels from various crude sources in the U. S. (see Table 1) and makes the statement: "It is interesting to note that 26% of the fuels, whose sources cover practically all producing fields in the country, are below 50 cetane number. Refiners in these areas would have to raise the cetane number of the straight-run stock either by adding ignition accelerators or by special refining methods." As to desirable cetane rating for high-speed Diesel fuels, the same authority said a committee of the Automotive Diesel Fuels Division of the Society of Automotive Engineers concluded that a fuel for engines of this type "should have a minimum cetane number of 47 to provide satisfactory engine performance" but that the government has decided this type of fuel must have a minimum rating of 50 cetane.

The patent (No. 2,221,839, Nov. 19, 1940, by David Lipkin) covering use of straight-chain aliphatic ethers states: "The ethers to be employed . . . have, in general, a boiling point not less than substantially 100°C. (212°F.) and are substantially miscible with hydrocarbon fuel oils. . . . The preferred compounds are the mono- and poly-ethers having straight-chain alkyl or substituted alkyl groups attached directly to the ether oxygen. . . . While it is preferable to employ ethers containing only straight-chain aliphatic groups, other ethers having a slightly branched long chain, e.g. diisoundecyl ether, have been found suitable."

"The following examples are illustrative of the results which may be obtained in accordance with the present invention. The cetane number of the fuel is employed herein as an index of the quality of the fuel, and an improvement in the fuel is expressed by an increase in the cetane number. The base fuel oil employed in the examples had an A.P.I. gravity of 23.3° and a distillation range of from 398°F. to 620°F.

Fuel	Ignition accelerator (vol. %)	Cetane No.
Fuel oil		36.4
Fuel oil	+10% n-butyl ether	41.0
Fuel oil	+25% n-amyl ether	43.7
Fuel oil	+25% monobutyl ether of diethylene glycol	44.5

"The quantity of ether employed will depend upon the degree of improvement required, and may vary from about 5% by volume of the fuel to 50% or 100%. The ethers of the present invention are characterized in having boiling points or boiling ranges above about 100°C. (212°F.) to about 300°C. (572°F.). Low boiling ethers such as methyl and ethyl ether are too volatile to be suitable as addition agents for compression ignition fuels, and such highly volatile ethers are not contemplated as within the scope of this invention."

Claim 3 of this patent is perhaps the most all-inclusive. It states: "3. A motor fuel for high speed Diesel engines having a boiling range substantially above that of gasoline, which comprises fuel oil and at least 5% by volume of an ether boiling within the range of from about 100°C. to about 300°C. and having the formula R-O-R′, wherein R and R′ are straight-chain alkyl groups."

Olefinic Nitrosites or Nitrosates

Another Atlantic-assigned patent (No. 2,244,496, June 3, 1941, by E. M. Marks) claims an improved Diesel fuel "obtained by reacting olefine hydrocarbons or hydrocarbon mixtures containing olefines with an oxide of nitrogen, particularly nitrogen trioxide or nitrogen tetroxide, to form nitrosites or nitrosates, respectively, and thereafter adding the nitrosite or nitrosate to fuel oil in an amount sufficient to substantially increase the cetane number of the fuel. Or, fuel oil containing olefines may be treated directly with the aforesaid oxides of nitrogen, thereby producing from the unsaturated oil components nitrosites or nitrosates which remain in solution in the fuel oil. Such treated fuel oil may be employed directly as a compression ignition fuel, or may be diluted to the desired extent with untreated fuel oil. In either case a fuel of improved cetane number is obtained, the increased cetane number being reflected in a lowering of the ignition temperature of the fuel oil and in a reduction in the delay period between injection and ignition of the fuel."

Eight examples of fuels improved by the use of nitrosites or nitrosates are given in the patent, including the preparation of the nitrogen trioxide and tetroxide. In one, a cracked gas-oil boiling between 281° and 605°F., of 28.3° A.P.I. gravity and with an aniline number of 86 was treated with nitrogen tetroxide at about 50°F. for 2 hours. The treated oil was washed with water to remove unreacted NO_2, dried with anhydrous calcium chloride, and tested for cetane number. Cetane number of untreated gas oil was 28, against 42 for the treated oil containing nitrosates.

Another gas oil, 34.8° A.P.I. gravity, 220° to 614°F. distillation range, and 124 aniline number, was treated with nitrogen tetroxide at 50°F. for 2 hours, then washed and dried. Cetane number of the nitrosate containing product was 56 against 37 for the untreated oil.

In still another example, the gas oil

Table 1—Cetane Numbers of Straight-Run Diesel Fuels From Various Crude Sources[3]

Crude Source	Cetane Number	Reference*
Pennsylvania	62	1
Pennsylvania	65	2
Kentucky	52	1
Michigan	68	1
Michigan	56	2
Indiana	52	2
Illinois	52	2
Kansas	59	2
Oklahoma	56	1 & 2
Louisiana	56	1
Louisiana	63	2
Arkansas	56	1
South Texas	32	2
East Texas	55	1
East Texas	57	2
West Texas	45	1
West Texas	48	2
West Texas	63	2
New Mexico	48	2
Wyoming	59	2
Wyoming	68	2
California	41	1
California	47	2

*Reference:

1. U.O.P. Booklet No. 189, "Ample Future Supply of Diesel Fuel Obtainable from Various Sources," W. H. Hubner & G. Egloff.
2. Preprint of SAE Paper, "A Cetane Number Study of Diesel Fuels," Oct. 23-4, 1941, Tulsa, Okla., G. W. Ainsley, et al.

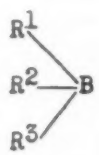
of the first example described above was treated with nitrogen trioxide at 80°F. for about two hours, washed and dried. Five per cent by volume of this nitrosite-containing oil was added to a 30.2° A.P.I. gas oil of 157 aniline number and boiling between 390° and 672°F. Cetane number of the unblended oil was 49, whereas the blend had a cetane number of 55. This same gas oil was blended with the same amount of oil from the first example, treated with nitrogen tetroxide at 32°F. for 1½ hours; the blend with nitrosite-containing oil had a cetane number of 53.

In two other examples, diamylene nitrosite and diamylene nitrosate were made by reacting commercial diamylene with nitrogen trioxide and nitrogen tetroxide, respectively. Using the diamylene nitrosite, 3 parts by volume were blended with a reference fuel composed of 60% by volume of paraffinic straight-run gas oil and 40% alpha-methyl naphthalene; unblended fuel had a cetane number of 44 while blended fuel rating was 54. Using the diamylene nitrosate, 3 parts by volume were mixed with the same reference fuel and found to have a cetane number of 55.

This patent, in which there are only two claims, mentions specifically a Diesel fuel blend made from a gas oil with diamylene nitrosite or nitrosate in quantity "sufficient to substantially increase the cetane number of the fuel oil."

Alkyl and Aryl Borines

The third and fourth Atlantic patents (No. 2,266,776 and 2,267,701, Dec. 23, 1941, by L. N. Leum) are concerned with cetane-number improvement by means of small amounts of organic borine compounds and derivatives thereof, having the general formula:



wherein R^1, R^2 and R^3 may be the same or different hydrocarbon groups. The patent states: "I have found that borines, the structure of which is such that the boron atom thereof is directly attached to a carbon atom only singly bonded to carbon or other atoms, are of particular utility as ignition accelerators for compression ignition fuels. For example, borines containing alkyl groups, cycloparaffin groups, and aryl groups attached to boron through a carbon atom other than a nuclear carbon atom are suitable for use as ignition accelerators, whereas those borines containing aryl groups directly bonded to boron are unsatisfactory for such purpose. I have further found that the branched-chain alkyl borines, such as the iso-alkyl borines, secondary alkyl borines, and, in particular, the tertiary alkyl borines, are superior to the borines containing normal alkyl groups, cycloparaffin groups, or methylene-substituted aryl groups, as ignition accelerators for Diesel fuels.

Table 2—Effect of Borine Additives As Ignition Accelerators For Diesel Fuels

Compound Added	Weight-Percent Added	Cetane No. of Blend	Cetane Number Increase
Base Fuel, clear*	0.00	43.7	....
Tri-n-butyl borine	0.50	49.1	5.4
Do	1.00	55.2	11.5
Do	2.50	65.7	22.0
Tri-n-butyl borine n-amyl amine	0.74	49.2	5.5
Tri-isobutyl borine	1.00	55.6	11.9
Tri-tertiary butyl borine	1.00	56.7	13.0
Tri-secondary octyl borine	1.00	57.5	13.8
Tri-cyclohexyl borine	1.00	54.5	10.8
Tri-benzyl borine	1.00	55.2	11.5
Tri-phenyl borine	1.00	44.3	0.6
Tri-naphthyl borine	1.00	43.9	0.2
Tri-n-butyl borate	1.00	44.4	0.7
Di-n-butyl boric acetate	1.00	43.9	0.2

*Base Fuel: 38.0° A.P.I. gravity, distillation range 330°-561° F.

"In general, all of the borines which I have found suitable as ignition accelerators or cetane improvers are susceptible to atmospheric oxidation to a greater or lesser extent. Such susceptibility may be markedly decreased, and in many cases entirely eliminated, by forming addition compounds of the borines with ammonia or substituted ammonias such as amines and nitrogenous organic bases, without decreasing the effectiveness of the borines as ignition accelerators."

Following a list of borines which are intended to be specifically covered by the patent is the simple method for converting them to forms less susceptible to atmospheric oxidation. This involves diluting the borine with an inert, low-boiling solvent, adding (preferably) an excess of the amine, and refluxing the mixture for a sufficient time to permit complete conversion of the borine to the borine-amino form. Excess amine and the solvent both are removed from the product by evaporation. Amines employed are those which have a carbon chain of sufficient length to increase the solubility of the borines in the fuel oil without decreasing the compound's efficiency as an ignition accelerator. (*See Table* 2)

From this table, it will be noted there is a marked effect from the addition of small quantities of organic boron compounds to Diesel fuels. The table shows that branched-chain alkyl borines, especially secondary and tertiary isomers, are superior to the straight-chain alkyl borines as well as the cyclo-paraffin and methylene-substituted aryl borines. On the other hand, the true aryl borines, esters of boric acid and alkyl boric acids are demonstrated to be of little or no value.

The two patents claim the invention of Diesel fuel additives comprising an organic borine containing at least one branched-chain hydrocarbon radical, or an organic borine-amine with the boron atom directly attached to a carbon atom only singly bonded to other atoms, to be added to the fuel in sufficient quantity to substantially increase the cetane number of the fuel. True aryl borines, esters or boric acid and alkyl boric acids are not considered within the patent's scope.

Light and Heavy Gas-Oil Blends With Asphalts, Other Pour Point Depressants

A patent issued Nov. 5, 1940 to C. C. Moore, Jr. and G. C. Shepherd Jr., and assigned to Union Oil Co. of California, claims a cetane improvement of Diesel fuel using a paraffinic gas oil with a pour point depressant, blends of light and heavy gas oils with a residual asphaltic hydrocarbon, and blends with pour point depressants. This patent states, in part:

"It is generally recognized that the ignition quality of a compression ignition engine fuel is largely a function of its paraffinicity and that, therefore, the highly paraffinic type of oil is preferable over the aromatic type of oil for use as fuel in high speed compression ignition or Diesel engines. Such highly paraffinic oil having a viscosity suitable for proper lubrication of the injection pumps and having efficient injection characteristics has, however, a high pour point such that it is not alone suitable for commercial use as a Diesel engine fuel where low temperatures are likely to be encountered. Thus, a heavy gas oil cut from a paraffinic or a mixed paraffinic and asphaltic crude oil is of a highly paraffinic waxy nature and has the low ignition lag characteristics which are desirable. This heavy gas oil has, however, . . . a higher pour point than is desirable in a commercial Diesel engine fuel which must be used under extreme variations in temperature conditions.

"However, such a high pour point gas oil may be rendered suitable for general use by blending into it suitable pour point depressants without sacrificing its inherent desirable ignition characteristics. There are a large number of such pour point depressants . . . . which may be employed.

"It has been found that certain high molecular weight bodies from petroleum are effective in depressing the pour point of oil's. These high molecular weight bodies are found associated with residual oil and especially with residual oil resulting from conversion processes and commonly known as "cracked" residuum. For example, the residuum obtained from the bottom of the evaporator in a Cross cracking plant is found to contain effective pour point depressants."

"While residua from cracking operations contain highly satisfactory pour point depressants, it has been found that crude oil residues resulting from normal straight run distillation operations also contain suitable pour point depressants and they may be blended with normally high pour point gas oils to form suitable low pour point fuels."

"Natural occurring asphalts or residual petroliferous material may also be blended with paraffinic hydrocarbon fractions also with similar satisfactory results."

"It is advantageous to blend heavy gas oil, light gas oil, producer's crude

and/or straight run residuum, together in varying proportions to produce Diesel engine fuels of various grades suited to particular types of engines. Table 3 (abridged) gives a tabulation of two typical compression ignition fuels resulting from such blends of these materials.

"The light gas oil blended in various proportions with the heavy gas oil according to Table 3 serves to adjust the fluidity or viscosity as well as the pour point, according to the requirements of the service for which it is intended. The allowable viscosity is limited by the value which will produce the optimum injection spray conditions as related to droplet size and penetration to effect maximum combustion efficiency.

"It has been observed that the ignition quality of a Diesel engine fuel was a function of its paraffinicity. An empirical expression for the paraffinicity of petroleum oil fractions has been developed from the viscosity-gravity relationships. . . . Since the viscosity-gravity constant is an expression of the paraffinicity of an oil then it logically follows that the viscosity-gravity constant of a Diesel engine fuel is also indicative of its ignition. This is shown to be true in Fig. 1, where the delay numbers of a variety of Diesel fuels as determined experimentally on a modified variable compression C.F.R. engine have been plotted against their respective viscosity-gravity constants.

" . . . . It is apparent, therefore, that the ignition quality of a compression-ignition fuel is a function of its paraffinicity, for which the viscosity-gravity constant is a satisfactory expression."

The inventors state the patent is not to be limited to the specific blended materials used as illustrations, nor to specific pour point depressants, but to include all materials and any pour point depressant within scope of the invention. Typical of the 12 claims of the patent are Claims 1 and 2, which cover a compression ignition engine fuel made by blending 60 to 75% of a paraffinic gas oil type with 25 to 40% of a residual asphaltic hydrocarbon, the blend having a viscosity-gravity constant in the approximate range of 0.845 to 0.895, 60 to 125 seconds Saybolt viscosity at 100°F., a cetane number between 41 and 58 and a pour point not exceeding 35°F. The gas oil also may be a blend of a heavy and a light type gas oil; a pour point depressant may be added to reinforce any naturally-occurring depressants.

Another patent owned by Union Oil was issued to C. C. Moore, Jr., Feb. 7, 1939, and is a method of controlling

Table 3—Effectiveness of Gas-Oil Blends Containing Pour-Point Depressants

Classification	Medium Diesel Engine Fuel Oil			Heavy Diesel Engine Fuel Oil		
Composition, % by volume:						
(1) Light gas oil			45			35
(2) Heavy gas oil			30			25
(3) Producers crude	15		25	15		40
(4) Straight run residuum	10		25	10		40
Test	**Specification Min.**	**Specification Max.**	**Typical Tests**	**Specification Min.**	**Specification Max.**	**Typical Tests**
Gravity, °A.P.I.	25.0	29.0	26.8	22.0	26.0	24.6
Viscosity, seconds @ 100° F.	61	80	70	91	125	106
Pour Point, °F.	10	35	30	0	35	35
Delay Number, ° crank angle			6.5			7
Cetene Number	47	58	52	41	54	49
Viscosity-Gravity constant	0.877	0.845		0.895	0.855	

(1) Paraffinic; gravity 30-35° A.P.I., viscosity 33-45 sec. Say. Univ. @ 100° F.
(2) Paraffinic; gravity 20-30° A.P.I., viscosity 50-80 sec. Say. Univ. @ 100° F.
(3) Non-paraffinic; gravity ± 14.5° A.P.I., viscosity 125 sec. Furol @ 122° F.
(4) Non-paraffinic; gravity 16-18° A.P.I., viscosity 125 sec. Furol @ 122° F.

ignition lag by means of injection of ozone—produced by a silent spark discharge apparatus mounted on the engine—blended with a fuel before injection, or injected from a storage tank directly into the compressed injection air.

In general, the invention covers a method of adding ozone to a Diesel fuel through the intake air, through an auxiliary inlet valve in the combustion zone, or through the compressed fuel-injection air or combinations thereof. Also covered is the fuel itself, comprising a mixture or solution of ozone in the fuel. Preferably, according to the inventor, the ozone is admixed with the inlet air through an ozonizer which forms an integral part of the air intake manifolding.

The air intake is divided into two chambers, each equipped with butterfly valves to control the proportions of ozonized and untreated air. The ozonizer itself works on the silent spark discharge principle, wherein the air passes between a cylindrical electrode and a concentrically-mounted rod electrode supplied with high-tension electricity furnished from an A.C. generator and high-tension transformer assembly.

Quantities of ozone required vary from 0.001% to several hundredths of one per cent, depending on the degree of ignition lag control desired and the character of the fuel employed.

In German literature recently reaching this country, there is reported the use of aldehyde and ketone peroxides as ignition accelerators. In this work, it was found the low molecular weight ketone and aldehyde peroxides were particularly active in increasing cetane numbers of Diesel fuels, one of the most effective being acetone peroxide, $(C_3H_6O_2)_n$ where "n" is 2 or 3. It is reported as readily soluble in the hydrocarbon fuels, a point which some other products tried did not have in their favor. The abstract[4] of the published work reports experimental results for a particular motor with other substances than peroxides added to the gas oil.

"Several different Diesel fuels were taken for the tests," it is stated, "one fuel oil, one of the different Diesel fuels with the cetane number 62.5 with additions of 2.5% of isoamyl nitrate, 1% of tetranitromethane, 25% of gasoline with an octane number of 87, 40% of alcohol and finally the fuel oil with a cetane number of 30 plus 1% of ethyl nitrate. The Diesel fuel with the cetane number 62.5 and the same fuel with the additions of isoamyl nitrate and gasoline showed similar diagrams though differing somewhat in details. Addition of alcohol caused large ignition delay and great speed of pressure rise, leading to rough running. Small amounts of alcohol allowed the motor to run more quietly and improved motor performance somewhat at the smoke limit. The fuel oil with the cetane number 30 caused hard running; greater ignition delay and pressure rise were noted. Adding ethyl nitrate raised the cetane number to 48. Ignition delay was less but would always be considerable.

"Summarizing, gas oils with high cetane number gave no more power than those with low cetane number but the ignition delay and speed of pressure rise were smaller, causing smoother running. Higher rpm and higher load pressure make it possible to use fuels of smaller cetane number. Ignition accelerators reduce ignition delay and velocity of pressure rise; they do not usually produce better engine performance. They do not accelerate combustion. Alcohol lowers performance as increasing amounts are added to gas oil."

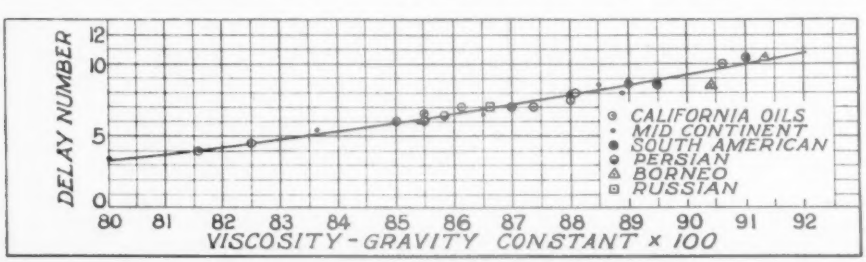


Fig. 1—Plot of C. F. R. engine delay number against viscosity-gravity constant of Diesel fuels from various crude sources

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Design of Anchor Bolts For Stacks and Towers

By E. F. Brummerstedt*

The use of taller fractionating towers in modern refineries emphasizes the importance of the methods used for calculating the actual tensile and compressive forces in determining the required anchor bolt area. A method is presented which, while more complex than some other published methods, may reduce the bolt and lugs and base plate requirements for high towers. An application is given for a tower 10 x 140 ft.

THE SUBJECT of anchor bolt design for stacks and towers has probably caused even more disagreement among engineers than combined stresses in tower shells, as previously discussed by the author. (1)

As long as 30 years ago many different methods were publicized and used in engineering design. (2) In a recent article (3) the simplest and most common of these methods was reviewed as part of a comprehensive dissertation. In Sect. 12 of reference (3) the equation for the stress in the shell plate due to the wind moment is given as $S = 4\,M/\pi\,D^2t$, wherein M is the wind moment, D is the outside diameter, and t the thickness of the tower shell. It must be emphasized, however, that this stress is the maximum at the extreme fibers only, tensile on the windward side and compressive on the leeward. This cannot, therefore be uniformly distributed around the circumference as was done in equation No. 34 in that article, which indicates that the stress per foot of circumference

$$= 4\,M / \pi\,D^2.$$

In Sect. 12 the article then proceeds to transfer this uniformly distributed stress to the anchor bolt circle, ignoring entirely the fact that an entirely different material, with a modulus of elasticity only 1/10 to 1/15 that of steel, now enters the cross-section of these bolts, breaking the continuity of the steel tower shell.

In Sect. 19 (f) the statement is made that bearing stresses of the steel tower on the concrete pedestal seldom cause any difficulty. Further on mention is made that these stresses are spread uniformly over the area of the base ring. With both of these statements the author disagrees. The question of magnitude and distribution of bearing stresses is an integral part of the solution for number and size of anchor bolts.

Analysis as Concrete Beam Section

A theoretical approach to the problem of anchoring a tall tower to a concrete foundation is to consider the section between the base ring and the concrete pedestal as a hollow cylindrical reinforced concrete cantilever beam of balanced design, with an axial load equal to the weight of the tower and an external bending moment equal to the wind moment. The tensile stresses in the anchor bolts and the compressive stresses in the concrete are then calculated in accordance with the theory of flexure. They vary from zero at the neutral axis to a maximum at the extreme fiber; they are not equally distributed. This implies that the base plate is stiffened sufficiently to be considered rigid with negligible deflection and that anchor bolt nuts are bearing without initial tension. The latter of these assumptions is not completely correct in actual conditions; it is the usual practice to place some initial tension on the anchor bolt while tightening the nut. For a theoretical analysis, however, that initial tension is negligible.

In Fig. 1 is illustrated the section between the base ring and the concrete pedestal. The bending moment is indicated by the force W at a distance E from the centerline O-O. E = Bending moment M in in.-lbs. divided by the weight of tower W in lbs. to give the equivalent eccentricity of the bending moment. As in a reinforced concrete beam, the neutral axis is assumed to be nearer the center of compression on the bearing surface of the concrete than the center of tension in the anchor bolts, due to the greater strength and allowable stress of the latter. Its location can be determined both analytically and graphically for any specified cross-section.

The determination of theoretical stresses in anchor bolts, therefore, becomes a matter of trial and error, with the number of bolts usually assumed first on the basis of the tower dimensions, so as to assure equitable stress distribution, and the size governed by the depth required for embedment to develop the full strength of the bolt. Because of the latter requirement it is customary to limit bolt diameters to 2½", although bolts up to 3" dia. can be used in exceptional cases. If the anchor bolt number and size both are assumed equally distributed on a bolt circle within the physical limits of the base plate, the location of the neutral axis can then be determined.

Derivation of Graphical Solution

As shown in Fig. 1, the compressive stress σ_c in the differential area dA is proportional to the distance y from the neutral axis n-n, or $\sigma_c = ky$, wherein k is a constant of proportionality.

Taking moments about the eccentric or load line under W, the summation of all forces

$$\int \sigma_c\, b\, d\, A = 0$$

$$\text{or } \int ky\, b\, d\, A = \int y\, b\, d\, A = 0$$

Substituting the expression dM for bdA to represent the moment of a differential area about the load line, the expression becomes

$$\int y\, dM = 0$$

By graphically representing the partial area-moments about the load line as parallel forces and constructing a ray force polygon, with the rays transferred to their corresponding locations under the center of their respective partial areas, the intersection of the first and last rays extended will locate the position of the neutral axis for that particular section and eccentric load. (4)

Having thus graphically located the neutral axis, the distances d, y_o and y_1 are established. The maximum concrete stress, σ_1 can then be calculated as follows:

$$\frac{\sigma_1}{y_1} = \frac{\sigma}{y} = k$$

$$\text{and } y = y_o - b.$$

The equation for the projected forces in Fig. 1 can then be developed further as

$$W = \int \sigma dA = k \int y dA = \frac{\sigma_1}{y_1} \int y dA$$

$$= \frac{\sigma_1}{y_1} \int (y_o - b) dA$$

resulting in

$$\sigma_1 = \frac{W y_1}{y_o \int dA - \int b dA}$$

which facilitates numerical solutions when expressed as

$$\sigma_1 = \frac{\frac{W}{\int dA} . y_1}{y_o - \frac{\int dM}{\int dA}}$$

The limits of integration are based on the actual compression area established by the location of the neutral axis. For the graphical solution the expression can be simplified to

$$\sigma_1 = \frac{\frac{W}{A} . y_1}{y_o - \frac{\Sigma M}{A}}$$

these values having already been determined during the graphical location of the neutral axis.

In order to differentiate between the elastic properties of the two materials, the factor n is introduced as the ratio between the modulus of elasticity of steel and concrete. The value of n varies from 10 for 3000 psi. concrete to 15 for 2000 psi. concrete. For the typical section in Fig. 1 the value of A is the sum of the compression area and the steel area in tension multiplied by n, or $A = A_c + nA_s$.

The value of ΣM similarly is the sum of the bolt moments and the compression area moments or $\Sigma M = \Sigma M_c + \Sigma nM_s$. Then the above formula can be amplified for the case of the reinforced concrete beam section in Fig. 1 as

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$$\frac{W}{\Sigma A_c + \Sigma n A_s} \cdot y_1$$

$$\sigma_1 = \frac{}{\Sigma M_c + \Sigma n M_s}$$

$$y_o - \frac{}{\Sigma A_c + \Sigma n A_s}$$

Then the maximum tensile stress occurs in the outer bolt and is equal to

$$\sigma_2 = \frac{n\sigma_1 y_2}{y_1}$$

In an actual problem the allowable stresses are given, and it may require several trials to select the most economical bolt circle so that the resulting stresses will not exceed the allowable.

Numerical Solution

The same principle (of the reinforced concrete beam) is illustrated in Hool & Kinne's "Reinforced Concrete & Masonry Structures" (5) in the discussion on reinforced concrete chimneys. In a typical solution following the method described therein, only the number of anchor bolts is assumed, and the diameter is to be determined directly. An attempt is made to calculate the position of the neutral axis analytically by the method of proportional triangles, using the allowable stresses as bases, as in Fig. 1,

$$\frac{nf_c}{y_1} = \frac{f_s}{(R_1+R_2)-y_1}$$ and solving for y_1.

This is not absolutely correct, because the final calculation will probably indicate actual stresses less than the allowable and hence the position of the neutral axis would no longer be exact for these lower stresses, but should be adjusted. The error in the location of the axis is not very great, however, and hence this method of locating it approximately is sufficiently accurate for most cases.

Having located the neutral axis, the centers of compression and tension can be calculated for their respective areas.

The number of bolts having been assumed, their position is known. The maximum stress in each bolt is calculated proportionately to its distance from the neutral axis, based on the maximum allowable stress in the extreme bolt. Assuming each bolt to have a unit area of 1 sq. in., the moment of inertia of each bolt around the neutral axis is calculated by multiplying its allowable stress by its distance from the neutral axis. The summation of all bolt inertia moments divided by the sum of the allowable stresses, which are static moments of the bolt area about the neutral axis, gives the distance $\overline{Y}_s$ from the neutral axis to the center of tension or bolt resistance moment.

The calculation for the center of compression involves the determination of static and inertia moments of areas bounded by curved lines, i. e., outside and inside radius of base. Analytically this is a problem in integral calculus which has been simplified in the above reference to the following equation for the distance from the center line of the tower to the center of concrete compression:

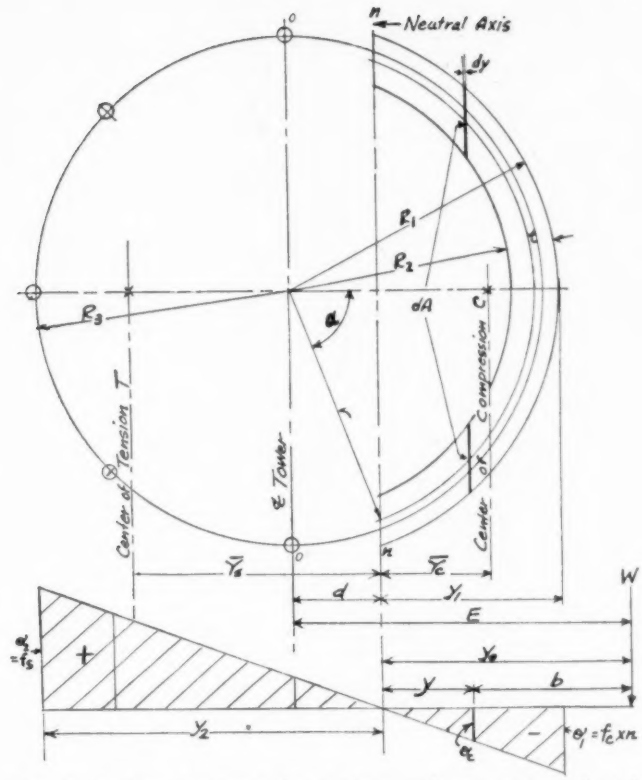


Fig. 1—Section between base ring and concrete pedestal

$$\overline{Y}_c + d = \frac{r}{2}\left(\frac{\alpha - \sin\alpha\cos\alpha}{\sin\alpha - \alpha\cos\alpha}\right)$$

wherein r=radius to center line of base ring (compression ring) and

α=angle in radians subtending half the arc formed by the above center line.

The allowable total compression on the concrete bearing surface is given as

$$C_1 = 2f_c rt\left(\frac{\sin\alpha - \alpha\cos\alpha}{1-\cos\alpha}\right)$$

where f_c=allowable bearing of steel on concrete at center of ring. This is determined by proportional distances to the extreme concrete edge for which the allowable stress is given, and t= width of ring in inches.

Having calculated the above values, the actual resultant forces can be determined by taking moments about the centers of tension and compression.

The actual tensile force is determined by taking moments about the center of compression:

$$T = \frac{M - W(\overline{Y}_c + d)}{\overline{Y}_s + \overline{Y}_c}$$

The actual compressive force is determined similarly by taking moments about the center of tension:

$$C = \frac{M + W(\overline{Y}_s - d)}{\overline{Y}_s + \overline{Y}_c}$$

The actual compression C must be less than the allowable previously calculated. The maximum theoretical tensile force T_1 in the bolts is then calculated proportional to the allowable compressive force,

$$\text{or } T_1 = T \times \frac{C_1}{C}.$$

Then the maximum allowable tensile moment must equal the bolt resisting moment, or $T_1 \times \overline{Y}_s = \Sigma M_B \times A_s$, and thus A_s can be determined.

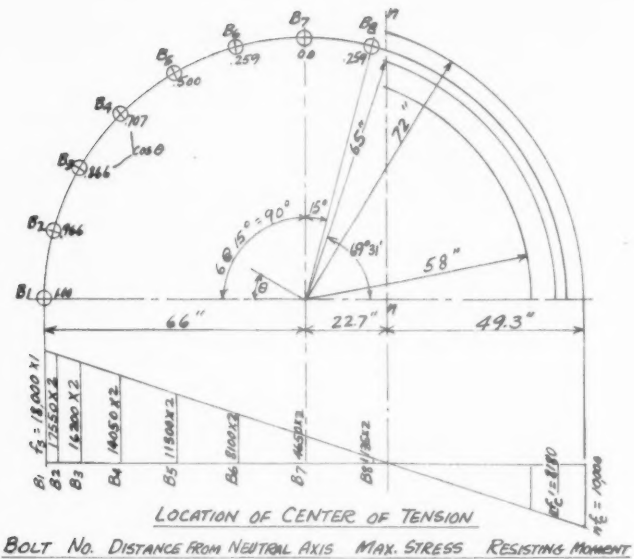
The actual stresses can then be recalculated on the basis of resultant forces.

A modification of the above method has been used wherein the location of the neutral axis is assumed, and the centers of tension and compression calculated as above. Having calculated the actual tensile and compressive forces by taking moments about these centers, the required bolt area can then be determined for that particular location of the neutral axis. If the actual diameter selected (next larger size bolt available) is within approximately 5% of the required, the assumed location of the neutral axis can be considered accurate enough, and actual maximum stresses calculated as above. If the stresses are too high, then a new assumption must be made and the process repeated until areas and stresses balance.

For small towers the use of these complex methods is not warranted, since the more conservative values given by the simple equation in Mr. Marshall's equation are not out of line. For tall towers and stacks a considerable saving can be effected by using the longer but more exact methods and reducing not only the size of the anchor bolts, but also the physical dimensions of the base plate and lugs.

Application of Numerical Solution

A large fractionating tower 10′x140′ high is designed to resist a seismic force equal to 20% of its operating weight of 600,000 lbs. applied at its center of gravity 65′ up, or a total seismic moment of 65x 120,000=7,800,000 ft-lbs. Assuming a base plate of 9′ 8″ I.D.×12′ 0″ O.D. and 24 bolts on an 11′ 0″ bolt circle, what dia-



BOLT	NO.	DISTANCE FROM NEUTRAL AXIS	MAX. STRESS	RESISTING MOMENT
B1	1	66 + 22.7 = 88.7"	18,000	1,595,000
B2	2	66 cos 15° + 22.7 = 86.5	35100	3045000
B3	2	66 cos 30° + 22.7 = 79.8	32400	2585000
B4	2	66 cos 45° + 22.7 = 69.3	28100	1965000
B5	2	66 cos 60° + 22.7 = 55.7	22600	1260000
B6	2	66 cos 75° + 22.7 = 39.8	16200	645000
B7	2	0 + 22.7 = 22.7	9300	211000
B8	2	22.7 - 66 cos 75° = 5.6	2270	12700
		TOTALS	163,970 in.²	11,318,700 in.⁴

$\overline{Y}_s = \frac{11,318,700}{163,970} = 69.1"$ PER SQ. IN. BOLT AREA

Fig. 2—Solution for a 10 x 140-ft. tower using the theory of a reinforced concrete beam

meter bolts are required in order not to exceed an allowable bolt stress of 18,000 psi and an allowable concrete bearing stress of 1000 psi for 3000 lb. concrete (n=10)?

Using formula No. 39 in Mr. Marshall's article, the pull per bolt $S_b = \frac{4M}{ND_b} - \frac{W}{N}$.

Substituting,

$$S_b = \frac{4\times 7,800,000}{24\times 11} - \frac{600,000}{24} = 93,000 \text{ lb.}$$

$$\text{Req'd. bolt area } A_b = \frac{93,000}{18,000} = 5.17 \text{ sq. in}$$

This would require a 3" diameter bolt, which is too large for proper embedment. More than 24 bolts could not practicably be spaced on an 11-ft. circle, hence the base would have to be increased to accommodate a larger number of bolts, or another bolt circle inside the tower skirt. Besides the additional material required, a larger base diameter would present difficulties in the way of handling, transportation, and thermal stress-relief, which is usually required on high-pressure towers.

The solution using the theory of a reinforced concrete beam according to Ref. No. 5, would give a more practical, exact, and economical result. (See Fig. 2).

Location of neutral axis:

$$\frac{nf_c}{y_1} = \frac{f_s}{(R_1+R_s)-y_1}$$

$$\text{or } \frac{10\times 1,000}{y_1} = \frac{18,000}{(72+66)-y_1}$$

solving, $y_1 = 49.3"$.

Distance of neutral axis from center line $= d = R_1 - y_1$

$\therefore d = 72 - 49.3 = 22.7"$

For location of center of tension, see Fig. 2.

Location of center of compression:

$$\overline{Y}_c + d = \frac{r}{2}\left(\frac{\alpha - \sin\alpha\cos\alpha}{\sin\alpha - \alpha\cos\alpha}\right)$$

$$\text{where } r = \frac{R_1+R_2}{2} = \frac{72+58}{2} = 65".$$

$$\cos\alpha = \frac{22.7}{65} = .350, \quad \sin\alpha = .937$$

and $\alpha = 69°\ 31' = 1.213$ radians.

$$\text{Then } \overline{Y}_c + d = \frac{65}{2}\left(\frac{1.213 - .937\times .350}{.937 - 1.213\times .350}\right) = 56.2"$$

$\therefore \overline{Y}_c = 56.2 - 22.7 = 33.5".$

Allowable total compression

$$C_1 = 2f_c rt\left(\frac{\sin\alpha - \alpha\cos\alpha}{1-\cos\alpha}\right)$$

$$\text{where } f_c = 1000\times\frac{65-22.7}{72-22.7} = 858 \text{ psi}$$

and $t = 72 - 58 = 14"$.

Then $C_1 =$

$$\left[2\times 858\times 65\times 14\left(\frac{.937 - 1.213\times .350}{1-.350}\right)\right] = 1,230,000 \text{ lb.}$$

Actual compressive force

$$C = \frac{M + W(\overline{Y}_s - d)}{\overline{Y}_s + \overline{Y}_c}$$

$$= \frac{7,800,000\times 12 + 600,000\ (69.1-22.7)}{69.1+33.5}$$

$$= 1,185,000 \text{ lb.}$$

Actual tensile force

$$T = \frac{M - W(\overline{Y}_c + d)}{\overline{Y}_s + \overline{Y}_c}$$

$$= \frac{7,800,000\times 12 - 600,000\ (56.2)}{102.6}$$

$$= 585,000 \text{ lb.}$$

Adjusting the above tensile force to the max. theoretical T_1, proportional to C_1,

$$T_1 = 585,000\times\frac{1,230,000}{1,185,000} = 607,000 \text{ lb.}$$

Thus the required bolt area

$$A_s = \frac{T_1\times\overline{Y}_s}{\Sigma M_B}$$

$$= \frac{607,000\times 69.1}{11,318,700} = 3.70 \text{ sq. in.}$$

$\therefore$ Use 2½" bolt = 3.72 sq. in.

Actual maximum pull on outer Bolt B

$$= 3.70\times 18,000\times\frac{585,000}{607,000} = 64,200 \text{ lb.}$$

Actual maximum stress on B_1

$$= 18,000\times\frac{585,000}{607,000}\times\frac{3.70}{3.72} = 17,250 \text{ psi.}$$

Actual maximum compression on concrete

$$= \frac{1,185,000}{1,230,000}\times 858\times\frac{49.3}{65-22.7} = 963 \text{ psi.}$$

Reduction in calculated pull per bolt—

Marshall formula	93,000 lb.
Hool & Kinne formula	64,200 lb.
	28,800 lb. or 31%

Per cent of bolt area required

$$\frac{\text{Hool \& Kinne}}{\text{Marshall}} = \frac{3.70}{5.17} = .715 \text{ or } 71.5\%$$

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Welded Refinery Equipment*

Recent Developments Include the Perfection of New Equipment to Meet High Temperatures and Pressures

*By Russell J. Love***

The severe temperature and pressure conditions encountered in refinery operations today have imposed new requirements in the design of vessels and their materials. Methods are described for welding alloy and composite materials in design of equipment. Case histories are cited to illustrate the supersize equipment and apparatus used. Types of catalysts employed in modern processes aggravate the problems of corrosion and abrasion, it is pointed out.

PETROLEUM refining used to be almost as simple as boiling sea water to recover salt. But today the petroleum chemist is confronted with problems more complex than the separation of the magnesium, bromine, and iodine from the sea. Recent developments require the petro-chemist to use not only extraction methods other than absorption and distillation, but also to use chemical and catalytic reactions involving many other reagents than the natural hydrocarbons.

New equipment has had to be developed for this new petroleum technology, as will be described. There will also be presented some of the details of construction, with particular reference to the materials used, and the various welding processes for joining these materials.

The separate types of equipment in a modern refinery are too numerous to treat individually. Furthermore, much repetition would occur were we to consider refinery equipment in terms of refinery processes, such as alkylation, polymerization, thermal and catalytic cracking, and so on. The most interesting aspects of recently developed equipment may be summarized as due to the increasing demands for:

1. Higher operating temperatures.
2. Higher operating pressures.
3. Larger pressure vessels.
4. Better resistance to corrosion and abrasion.

These four topics will be discussed separately, although the conditions represented often occur all together.

Higher Temperatures

Operating temperatures of 750° F., and upward to 1100° F. are more and more frequently encountered. Thermal cracking for quite a few years has employed temperatures from 850 to 1000° F. But some catalytic cracking processes now require operation at over 1000° F. At these temperatures metals are actually red hot. And for operation at red heat, the selection of materials and the design of equipment must take into account the following factors:

A. The high temperature strength of the material (resistance to creep).

B. The possibility of temperature embrittlement.

C. The accelerated corrosion rates at high temperatures.

In meeting the three conditions (A, B, and C) present when high temperature is encountered, the materials used very greatly influence design of the equipment. Following are a few examples of design and fabrication considerations, as related to the material selected.

Straight carbon-molybdenum steel (A.S.T.M. A-204) may be selected for creep strength (factor A), but it may not satisfy conditions B or C. In other words, although the creep strength of carbon-moly is about twice that of carbon steel at 1000° F., operating conditions at this temperature may induce temperature embrittlement, or the C-Mo steel may offer inadequate resistance to corrosion.

Chromium Reduces Risk

It has been found that the addition of chromium, even in relatively small amounts, to carbon-moly steel materially reduces the risk of temperature embrittlement, and may add to the creep resistance. As little as 1.25% chromium with 0.5% moly may be used to satisfy factors A and B. But this small amount of chromium usually is not sufficient to improve the corrosion resistance very much.

The high temperature corrosion problem alone has three distinct elements: First, atmospheric corrosion, which at lower temperatures is almost no problem at all; second, the special type of heat corrosion encountered in those cases where equipment is direct fired or in contact with hot furnace gases; and third, the corrosion due to the process fluids. A further discussion of the corrosion problem is included in the latter part of this paper.

When creep and embrittlement and corrosion are all expected, the economic solution is sometimes found in the use of plain carbon-moly steel for the pipe or vessel wall, to provide the necessary creep-strength, plus the use of a liner of high alloy material to resist the corrosion or embrittlement that the process fluid would otherwise cause. The various forms that the liner may take, such as cladding, plating, or separately attached lining, will be discussed more in detail.

It is indeed fortunate that welding processes and techniques have been well developed for materials other than plain carbon steel. It is by virtue of the versatility of welding that the alloy or composite materials often necessary for high operating temperatures can be fabricated in the size and shape necessary for almost everything from simple pipe to complicated heat exchangers. Moreover, welded attachment of alloy linings, whether by fusion plug welding or by resistance spot welding, is often the most economical method of providing such linings. And when clad material is used, though it may be costly, the cost is minimized if fabricated by proper welding methods.

Designing equipment for high operating temperature involves perhaps the most complex combinations of low and high alloy materials. Accordingly, at this point we will tentatively postpone the topics of high pressures, and large vessels, and some of the methods of welding alloy materials and composite materials will be mentioned.

A Troublesome Alloy

It has been found that electric fusion welding is entirely satisfactory for most of the low-alloy steels, if proper welding rods are selected, and the special preheating precautions necessary in some cases are observed. There is one low-chrome alloy, however, that has been quite troublesome. It is the type 501 or type 502 stainless commonly called 4-6% chrome. This alloy has a marked tendency to air-harden in the temperature range around 500° F., and any welding process employed is bound to create a temperature gradient extending into this air hardening range, unless something is done about it. What usually has to be done, is to maintain a preheat temperature above the air hardening range and conduct all welding operations at or above, say, 500° F.

Furthermore, the anneal necessary to stabilize the properties of this alloy must follow the welding without loss of the preheat temperature. In other words, to avoid the air hardening effect which may cause embrittlement or actual cracking of the material or the welds, a very elaborate setup is required, and much discomfort is involved for the welding operator. Because of these conditions, it is sometimes more practical to use the more expensive but easier to weld higher-chrome alloys, such as 11-13% chrome, even though a lower chromium content would satisfy the operating temperature or corrosion problem.

The welding complications just described are often alleviated by the use of good old-fashioned acetylene welding, with its wider heated zone in the vicinity of the joint, but this process does not provide much of a protective envelope over the weld being made. The atomic-hydrogen process is often superior, be-

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cause it combines the ability to create a broad heating band, with a well-nigh perfect reducing atmosphere (the hydrogen envelope). Another welding process, the very recently developed Heliarc, or helium-envelope weld, has not yet been applied to welding of the alloys encountered in modern refinery practice.

In connection with the fabrication of apparatus by welding, the details of the shaping and preparing of the edges to be welded, are very important. The design of welded joints will vary according to:

(a) Whether the joint is to be made in the shop or in the field.
(b) The size of the part being welded —which may determine whether both inside and outside welding can be done, or whether all welding must be from the outside only.
(c) The thickness of the main wall.
(d) Whether the wall is clad or lined.

Space does not permit a complete discussion of the many types of welded joints for composite materials, but it should be mentioned that whenever there is a considerable difference between the composition of the main wall, (the "parent metal") and the composition of the cladding or lining, contamination is a serious problem.

Contamination Problem

Contamination, sometimes called dilution, means either

(1) detrimental dissolving of excess carbon from the carbon steel (or the dissolving of carbon steel itself) into the higher alloy steel, or,
(2) it may mean the contaminating effect of some of the alloying constituents migrating into the weld joining adjacent portions of the parent metal.

In case (2), the effect is usually bad because of the formation of an imperfect alloy in the weld itself which may seriously weaken the joint. It is obvious that the strength of the vessel or pipe is dependent upon the joint between the parent metal, because the strength of lining or cladding is seldom if ever taken into account in the design. The pressure-vessel codes allow no credit for liners or the alloy portion of clad plates, in computing the strength of the vessel.

In case (1), the detrimental effect is primarily due to carbon pick-up spoiling the anticorrosion properties of the alloy, or secondary effects such as checking.

Low Temperature Operations

While on the subject of temperature, and before proceeding to our discussion of high operating pressures, mention should be made of the present status of low operating temperatures in today's refineries. Although alkylation processes, cold acid treating, and solvent extraction all commonly use refrigeration, the low operating temperatures have not become materially worse from a design standpoint, than those low temperatures encountered some 10 years ago in solvent dewaxing. At that time, investigations were made of the special design problems incidental to low operating temperatures (around minus 100° F.), where the main question was that of impact strength, and where the generally acknowledged answer was the use of nickel steel, containing from 2½ to 4% nickel.

Such steel was found to be weldable and is still commonly used for low temperature applications. Now, still speaking of cold temperatures, we can only go down 460° below zero F. and no lower. Up toward the other end of the thermometer, however, even 1000° F. may not be the limit. According to one authority, thermal polymerization employs temperatures up to 1100° F., and tomorrow the industry may need to go still higher.

High Pressure and Super-pressure

It is almost obsolete to refer to an absorber working at over 400 psi as a "high pressure" absorber. Nowadays, one thinks of pressures from 750 to 1500

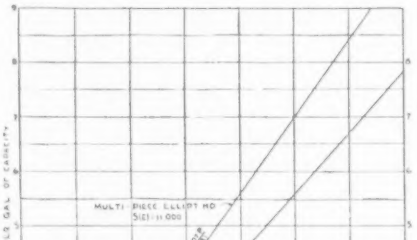

Fig. 1—Weight per unit of volume for various types of container vessels for different pressures

psi as high pressure, although the limits are very indefinite. Where high pressure ends and super-pressure begins is an open question. (Super-pressure is not just a funnypaper name, like Superman.) One authority considers pressures over 100 atmospheres, roughly 1500 psi, and up to 50,000 psi, to be super-pressures. Another states that the best definition is that we are dealing with super-pressure if the cylinder wall thickness exceeds 10% of the diameter. Suffice it to say that high pressures, 500 to 1500 psi, are becoming quite common, and that full-scale operation at 3000 psi is not unheard of, and that at least one instrument company has a well developed line of laboratory and pilot plant equipment for up to 50,000 psi.

Even for the moderately high pressures around 1000 psi, the design of equipment must take into account many more factors than when dealing with only 100 psi. The designer of high pressure equipment must consider:

1. Suitable materials, carbon steel or high strength alloys.
2. Size and shape factors (see Fig. 1 and below).
3. Type of construction
   a. Rolled and welded: single plate wall, or multiple layers.
   b. Seamless: forged, drawn, cast, or bored from solid.
   c. Combinations of a. and b., such as welded attachments on a seamless shell.

These factors will be considered in the order presented above. Selection of material for high pressure construction is almost always determined by making an economic balance between massive carbon steel and expensive alloy steel. This economic balance, however, involves more than simply material and fabrication costs; the availability and suitability of the material must be considered also. As in high temperature design, the action or reaction of the process fluid on the material is often of supreme importance. And if high pressure is accompanied by high temperature, all of the factors under each of these headings must be considered fully. Fortunately, the materials outlined under the preceding discussion of high temperature operations have higher-than-ordinary tensile strength, and hence are advantageous in meeting the requirements of high pressure.

For example, carbon-moly steel, often selected for high temperatures because of its better creep strength, is available in three grades A, B, and C, and has minimum (cold) tensile-strengths respectively of 65,000 psi, 70,000 psi, and 75,000 psi. Another example is to make the main wall of the vessel of the strongest suitable inexpensive material, and employ a liner to meet the heat or chemical-corrosion problem. For instance, a fusion welding piping assembly (pipe fabricated by rolling and welding clad plates), uses carbon-moly base metal with 18-8 stainless cladding, the carbon-moly to provide strength at high temperatures, and the stainless to provide resistance to corrosion of the flowing catalyst.

Some Alloys Unavailable

When high pressure alone is being considered, uncomplicated by high temperature or severe corrosion, the lowest cost high strength steels are carbon-silicon (A.S.T.M. A94, A201, and A212) or carbon-manganese (A-225). Until sidetracked by the advent of the present war, the low alloy steels known as Corten, and Mayari-R, also provided a low cost high strength material, both easily workable and easily weldable.

In high-pressure vessels, shape and size are not mere factors of convenience. The process requirements for size may

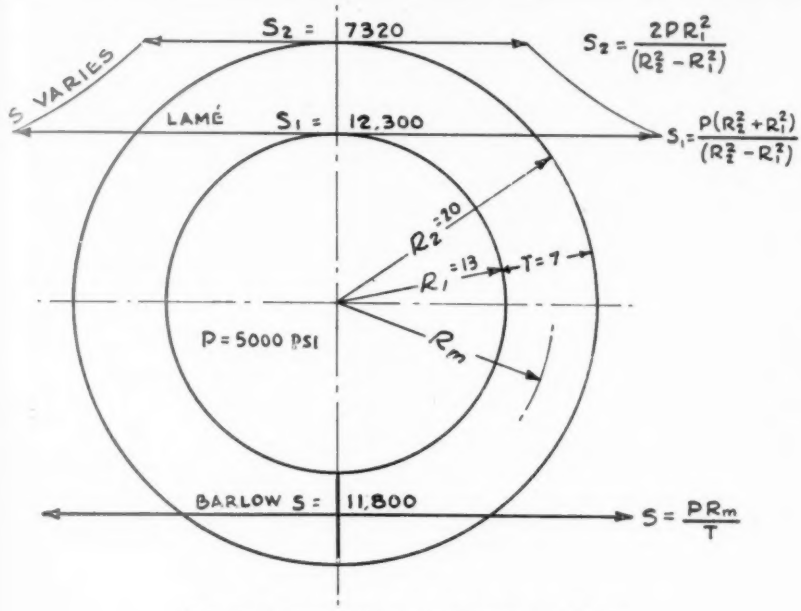

Fig. 2—Stresses in a thick-walled cylinder

have to be modified to permit selection of an economic design. The cost per cubic foot becomes a matter of much money when pressures of 1500 psi and upward are encountered. Small diameters minimize the cost, but some reactions, particularly catalysis, may require as large an area as possible, hence the need for balance between the factors of size, shape, material, construction, and operation.

The type of construction to be employed in a vessel for high presure will determine to some extent what materials may be employed. For instance, in seamless forged, or bored-from-the-solid, or cast vessels, high strength may be provided by high carbon content alone. Doing so, however, may preclude the possibility of making any attachment by welding. As has already been pointed out, carbon-moly or the stainless steels, whether used as the main vessel-walls or as liners, can readily be welded.

Welding has also made possible some very interesting combination designs for high pressures, such as long-stroke pumps made by welding two or more forged steel parts together; the welding of the outer barrels for Hydropress pumps, and the familiar examples of welding pressed heads onto seamless bored or forged cylinders, or of welding forged or cast steel nozzle flanges onto seamless necks.

Welding has made possible the recent development of multiple layer pressure vessels, an example being a vessel in hydrogenation service at high temperature; it is 36 in. inside diameter, built of 20 layers, for a working pressure of 3000 psi. Whenever possible all connections leading into multiple-layer vessels are made through the head, inasmuch as nozzle attachment to the laminated shell is something of a problem.

Since the high pressures and superpressures being discussed very often involve thickness-to-diameter ratios of over 10%, and when this relation exists specialized formulas should be used, Fig. 2 has been prepared to show the difference between the usual Barlow formula for computing ordinary pressure vessels, and the Lame and other formulas for thick-walled vessels.

Supersize Equipment

Among the most outstanding, literally outstanding, features of the newer refineries, particularly those producing synthetic rubber ingredients and toluene, is the supersize of some of the vessels and the structures for them. This is not only because of large throughputs or large outputs (some of the plants probably wish their outputs were larger), but because of the process requirements. Superfractionation involves more and more trays, which means higher and higher towers. Semi-batch processes require very large volumes to maintain some semblance of continuous flow with reasonable off-stream, on-stream cycles. And catalytic reactions often require catalyst beds with large areas or volumes.

The recently developed equipment and apparatus exemplifying supersize can best be described by citing a few case histories as follows:

Case I

A deisopentanizer tower now being built is 96 in. diam. x 175 ft. high over all, contains 70 bubble trays, and weighs 150,000 lb. without the trays. It is designed to be self-supporting, having an extended base heavily reinforced. Although the topmost part of the shell is only ⅜ in. thick, such factors as resistance to earthquake, hydrostatic loads and wind loads require that the shell be thicker and thicker toward the base, and we find the thickness of the lowest course to be 1-3/16 in. In fact, the thickness-to-diameter ratio of the lower 68 ft. of the shell height is such that that portion must be stress relieved to comply with the A.P.I. A.S.M.E. Code. This is truly a super fractionator.

Case II

Very tall bubble towers, even though nominally self-supporting by virtue of properly designed bases, may suffer troublesome vibration if they are very slender. Typical of the modern treatment of this problem is the case of a deisopentanizer column only 4 ft. diam. but 90 ft. high, which required bracing. Instead of a multiplicity of guy wires attached at various elevations, which would have formed a network overhead, it was decided to use harmonic sway bracing, consisting of three trusses equally spaced around the circumference of the tower. Each truss consisted of a steel cable attached at the top and bottom of the tower by welded clips, and each cable was spread at the center by a 3-ft. strut. Singing, or vibration of the truss wires themselves is avoided by using vibration dampeners between the turnbuckle and the attachment at the bottom of the column.

Case III

A typical reactor for a fluid catalyst cracking unit is 27 ft. diam. x 87 ft. high, having 50 ft. of this height the full 27 ft. diameter. The top head is a 90-degree cone, and the bottom head is similar except that it has a 10-ft. diameter x 13-ft. deep sump appended. The main support ring is at the bottom of the 27-ft. shell, where the vessel rests on a special elevated structural support. The main shell is 1½ in. thick, the cone heads 2 in. thick, and the entire vessel is made of Pluramelt (a clad plate, in this case with 20% Type 347 stainless on the inside, the remaining 80% being carbon-silicon high tensile plate.) Although the operating pressure is low, the operating temperature is about 1000° F. The required stress relief was the subject of debate: whether to stress relieve in the field by building a fire inside, or whether to let the 1000-degree operating temperature do the trick.

Case IV

A typical catalyst regenerator operates at 1100° F. (red hot), is 42 ft. in diameter x 35 ft. straight shell, and has a 90-degree cone bottom. The top is a practical combination of cone and dome, having about 2/3 composed of 90-degree cone, and the upper 1/3 bridged over with a portion of a sphere. Just a chamber, having no internal parts, but being constructed of 1 in. plate for the shell and 1¼ in. plate for the cones, it weighs over 200 tons empty.

Because the catalyst flow from this regenerator is by gravity, this whole vessel is mounted at the topmost part of a structure built like a 20-story building. The operating temperature (1100° F.) will do the stress relieving.

Case V

Typical catalyst hoppers are 30 or 32 ft. diameter x about 80 ft. high over all and have conical bottoms and full hemispherical top heads. Design is for 5

psi working pressure at 650° F. As in the case of very tall fractionating towers, the shell thickness varies from top to bottom. These hoppers are about ½ in. thick at the top and each course of shell plate, proceeding downward, is usually 1/16 to ⅛ in. thicker, making the bottom course about 1 in.

Case VI

Although standard A.P.I. storage tanks with cone roofs or floating roofs, continue to be generally used for storage of low vapor pressure fluids, there has been an interesting development of containers for high vapor pressure fluids. Spheres and spheroids are adaptable to pressures from 10 to 100 psi, and volumes up to tens of thousands of barrels. Large diameter vertical pressure containers have been used, and supersize horizontal cylindrical tanks are now being constructed for pressure storage of liquids.

An example of a recently developed special design of horizontal pressure tank of large capacity is located in the Los Angeles area. It is 38 ft. in diameter x 114 ft. long, for a working pressure of 60 psi. The novel feature is the method of support. Instead of two piers or cradles, which would require two ring girders to maintain the tank round at the points of support and would involve sliding bearings or rockers at one end to allow for expansion, a central support is used.

The ring girder at this point is inside the tank shell, and the whole thing looks like a blimp almost floating in mid-air. The advantages, of course, are freedom to expand and contract, or to curve under the differential heating of the sun's rays, and, it is claimed, ease of field erection resulting in low cost per gallon of contents. Reference to Fig. 1 will show that, in comparison to spherical containers, the cylindrical type is not at such a disadvantage as many believe. Just because for a given pressure and diameter a sphere needs to be only half as thick as a cylinder, does not mean that the weight or cost of a sphere will be half that of a cylindrical tank for a given capacity.

Shipping and Erection Problems

The transportation and construction problems in building supersize vessels are many. Super fractionators often require shipment in two or more sections, to be joined by welding in the field, usually before erection. The gargantuan catalyst equipment obviously cannot be shipped fully assembled. Erection becomes a matter of assembling, plate by plate, the individual pieces after prefabrication and transporting to the site. Even so, rather heavy lifts are involved in building those vessels with plate thickness over 1 in. For example, a 1½ in. plate 8 ft. wide x 30 ft. long weighs 15,000 pounds. Such plates must be lifted to fantastic heights to assemble a catalytic reactor, say, on the 14th floor of the building. Field welding of these vessels, as is evident from the construction details given in the case histories, may involve all the problems connected with welding of composite materials as discussed under the topic of high temperature. Doing such welding in the field means that every precaution must be taken to insure the safety both of the men and materials during construction, and also safety of operation of the finished vessel.

Corrosion And Abrasion

All of the "old" corrosion problems are still with us, and a host of new ones are at hand. As has already been mentioned, any or all corrosion is aggravated by the higher temperatures of operation. Many of the old corrosion problems were adequately solved by simply providing extra metal for corrosion allowance. Most of the new corrosion "gremlins" are not stopped that easily. The prevention of chemical attack, of heat or stress corrosion, of embrittlement and of hydrogen penetration, may require the most expensive materials and the best fabrication knowledge available.

The use of substances heretofore foreign to refinery operations requires the careful adaptation of materials equally foreign to the usual refinery experience. Here are a few examples.

Hydrochloric acid may occur in such form and such concentrations that only a very high alloy like Hastelloy will endure. In one such case, a liner of Hastelloy is installed in the lower section and bottom cone of a tower, and also within the necks of certain nozzles. Attachment is by plug welding, except that small diameter nozzles may be of solid Hastelloy. Because this alloy costs several times as much as 18-8 stainless steel, its use is generally limited to zones of expected corrosion where nothing else will do. In welding Hastelloy the welds tend to be porous; remelting of the weld in a carefully controlled atmosphere boils out the porosity and gives a smooth bead. The atomic-hydrogen arc is especially well suited to this "sealing" operation, but the acetylene flame also can be used successfully.

Anhydrous hydrofluoric acid is another of the newcomers. When most of us were first introduced to hydrofluoric acid, we learned its salient property was that it couldn't be kept in glass bottles, and this property has earned for HF an undeservedly bad reputation for supercorrosion. Just like concentrated H_2SO_4, and anhydrous HCl, according to C. M. Fehr,(1) anhydrous HF can be tolerated by any good steel. By contrast, at concentrations over 65% it attacks lead rapidly. Welded or cast steel equipment, therefore may be used, but be sure that the acid is known to be anhydrous or nearly so.

Ammonia is not only a refrigerant but also is a reagent or catalyst, as in modern toluene plants. Some of us may need the reminder not to use brass or copper in ammonia's presence, not even to braze a cracked compressor head, if the ammonia is to be held.

Hydrogen sulfide, no newcomer to the group of corrosion gremlins, nevertheless brings new headaches when it appears in some of the new processes. In one case where H_2S was present at a temperature of 900° F., the piping and accessories had to be stainless steel, 18-8 with 3% moly. In another case, this insidious compound H_2S had to be removed because it acted as a poison, spoiling the action of phosphoric acid as the catalyst in making polymer gasoline. In absorbing or otherwise separating H_2S from a gas stream, a weak acid may be formed and lead lining (if temperature permits) may be needed to avoid this corrosion.

The nonferrous materials, notably copper and Everdur, Monel, Inconel, and nickel are becoming increasingly useful in meeting new conditions of corrosion, or in some cases conditions requiring non-contamination of the products by iron. Fortunately, the chemical process and food industries in solving similar problems caused the development of dependable methods of working these nonferrous materials into exchangers, pressure vessels, etc.

Chemical Process Problems

Some reactions with the metal walls of equipment cause chemical deterioration of ordinary materials of construction. Caustic embrittlement is one, and the new processes are bringing more similar reactions, like hydrogen attack.

Many of the newer cracking and reforming operations involve dehydrogenation. In these, as well as in the direct hydrogenation process, the presence of free hydrogen may cause the phenomenon known as hydrogen penetration. This causes progressive deterioration of the steel and to date, it is said, no fully satisfactory remedy has been found. Vessels have been made with walls twice as thick as would otherwise be required but the hydrogen seeps through.

Now a word about abrasion. Without referring too specifically to the mechanism of the several new catalytic processes, it may be said that at least two of them use finely divided solids as catalysts, and these fine solids are caused to flow in suspension in fluids. During this flow, and in the subsequent separation (in one process) the solid particles act abrasively. Equipment handling this mixed flow condition may be either of abrasive-resistant material like the workable low manganese alloy steels, or the anticorrosion claddings or liners by virtue of their generally better physical properties—hardness and tensile strength—may offer long enough life to get by. And if temperature permits, we should not overlook the fact that rubber linings, good for both abrasion and/or corrosion, are available on high priority.

(1) Fehr, Charles M., "Safe Handling of AHF", Technical Section, NATIONAL PETROLEUM NEWS, Aug. 4, 1943, p. R-364.

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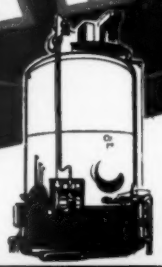

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DESALTING **DEHYDRATING**

WELDING STAINLESS STEELS*

The processing of the so-called sour crudes in refineries formerly utilizing the sweet or low sulfur crudes will require greater use of stainless and chrome-molybdenum steels in the control of acid corrosion. Welding operators in plants will be required to handle more of these types of steels and some refining authorities have stated there will be critical need for welders experienced with the alloy steels. The commercial techniques employed in the welding of stainless steels are presented, together with the precautions to be observed, from the experience of an established manufacturer of these steels.

STAINLESS STEELS, no matter what their composition, all possess two common characteristics: They are all resistant to corrosion and oxidation and all are affected in some manner by the application of heat. Resistance to corrosion and oxidation is imparted by the inclusion of the element chromium in amounts over 10%.

Stainless steels may be divided, roughly, into two main groups, straight chromium alloys and chromium-nickel alloys. Both may also contain varying small percentages of manganese, columbium, titanium, aluminum, carbon, silicon, and nitrogen, one or more of which has been added to increase the strength of the alloy, its resistance to corrosion, to control carbide precipitation, or for still other purposes. About 24 such stainless steel alloys are in common use today; new ones are in developmental stages.

Heat applied to some of these alloys can affect both corrosion resistance and physical properties. Since welding is an operation in which intense heat is employed, welders and designers must have a knowledge of how each of these steels behaves under its influence, and how to anticipate its effects so that they either may be avoided, utilized, or controlled.

Stainless steels containing both nickel and chromium are considered more readily and satisfactorily welded than those containing chromium only. The former are called "austenitic steels"—which describes the metallurgical structure—and weld joints are characterized by high strength, ductility, and toughness in the "as welded" condition. This makes unnecessary post-welding heat treatment and annealing to improve physical strength. The straight-chromium steels of up to 14% Cr content will harden intensely if they are allowed to cool rapidly in air after welding but are susceptible to heat treatment which imparts a wide range of physical properties. Straight chromium steels containing from 18% Cr up to 30% do not respond to heat treatment and do not harden when cooled rapidly. Intermediate straight chromium steels—between 14% and 18% Cr—have borderline characteristics which depend strictly on their chromium and carbon content.

Steels in the chromium-nickel group are in the best condition to resist corrosion when they are in their normal austenitic condition. This is developed by heating them to around 1900° F., holding them for a period sufficiently long to insure uniform temperature and then cooling them to below 800° F. in less than 3 minutes. However, if a piece of this steel, say 18% Cr, 8% Ni, 0.08% C (maximum), for example, in the fully-annealed or dead-soft condition just explained, is heated to a temperature of approximately 1200° F. and held there for an appreciable length of time, carbon separates out of the austenitic solid solution and unites with chromium to form carbides. These carbides precipitate along the inter-crystalline boundary lines and render that area strongly liable to corrosion by many types of strongly-corrosive agents. Carbide precipitation does not, however, appreciably alter the tensile and yield strengths of the alloy.

The speed with which carbide precipitation takes place varies with a number of factors: (See Fig. 1)

1. The longer the time during which the material is held within this carbide precipitation range, the more carbides will precipitate.

2. The closer the actual temperature is to 1200° F., the more harmful the precipitation.

3. The more carbon the metal contains, the more there will be to combine with chromium, which is to say that the high-carbon, chromium-nickel steels are more susceptible to formation and precipitation of carbides than those with low carbon content.

4. The greater the sum of the chromium and nickel percentage in comparison with the carbon percentage, the less rapid the forming of carbides will be. For example, 18.5% Cr and 8.5% Ni (total 27%) with 0.08% C will form carbides less rapidly than one with 17.5% Cr, 7.5% Ni (total 25%), and 0.08% C—other things being equal.

For control, it is necessary to avoid too long a time at temperatures within the carbide precipitation range (800-1500° F.), and to employ steels in which content of Cr, Ni, and C are present in the proper ratios to balance one another. Still another method of control, which is not feasible in all cases of refinery construction, is to remove carbides by heating the steel to 1900° F., holding until uniform temperatures are obtained throughout the steel, then cooling to below 800° F. within 3 minutes. Naturally if the vessel or article which has been welded is large in over-all dimensions or the sections are excessively

Photograph above shows welding a lining of stainless steel in a pressure vessel at the Richfield Oil Corp., refinery, Watson, Calif.

*All material in this article is from the book, "Welding Stainless Steels", published by Allegheny Ludlum Steel Corp., Brackenridge, Pa.

massive, such heat-treating is impractical.

One of the most commonly used "dodges" to avoid carbide formation and the necessity for post-welding heat treatment is to include titanium or columbium in the alloy itself, as well as columbium in the welding rods. Both of these elements preferentially form carbides, forestalling formation of chromium carbides, and titanium or columbium carbides do not impair corrosion resistance. Titanium, however, is not transferred through welding flame or arc from rod to weld deposit; hence it is not included in the welding rod metal.

Some other characteristics of chrome-nickel alloy steels of interest to the welder, designer, and operating man may be best explained by contrasting with ordinary carbon steels.

1. These stainless steels have an expansion coefficient which is approximately 150% that of ordinary steel. Distortion and warping, as well as development of residual stresses must be allowed for in a corresponding amount.

2. Heat conductivity ranges from 40 to 50% that of carbon steel. Since they do not cool off as fast as ordinary steel, higher-than-expected temperatures will develop along the weld joint, which, coupled with the higher expansion coefficient, makes for greater distortion and development of residual stresses.

3. Electrical resistance for chrome-nickel stainless is around six times greater than for carbon steel, and may go as high as 12 times greater in cold-worked sections. Lower welding currents can thus be employed.

4. Melting points are slightly lower for Cr-Ni stainless; less heat is required to melt them. This, coupled with high electrical resistance, means welding currents can be sharply reduced from values generally employed in welding ordinary steel.

5. Chrome-nickel alloys do not harden under heat treatment. If brittleness results from increased grain size, always induced by subjection to high temperatures, the only cure is to cold-work the metal. Annealing is useful only to stress-relieve and to destroy carbides.

Straight Chromium Steels

The stainless steels which do not contain nickel are more difficult to handle, as far as the welder is concerned, than those which do. This is because the heat of welding leaves them in a brittle condition. They do have the advantage, however, of not being subject to carbide precipitation and thus suffer no loss of corrosion-resistance after being subjected to the high temperatures of welding. Best way to understand the effect of heat on these steels is to compare them with ordinary steel:

1. The coefficients of expansion of straight chromium steels are about the same or slightly less than ordinary steel; they do not expand any more.

2. The heat conductivity varies from one-half to two-thirds that of ordinary steel, which means they hold heat longer.

3. Their electrical resistance varies from 3 to 6 times that of ordinary steel.

4. Melting points are slightly below that of plain steel.

If the straight chromium alloys are held at a temperature exceeding 1650° F. for any length of time, they tend to increase their grain size, resulting in increased brittleness. Also, if allowed to cool slowly from around 1200° F, brittleness may result. Brittleness must not be confused with hardness, for with the high chromium alloys no response to heat-treatment is noted although the embrittling may actually increase.

Embrittlement occurring from temperatures in excess of 1650° F., which permit increased grain size, cannot be cured by heat-treatment; mill procedures are necessary which are not usually practicable or available to the welder. Brittleness occurring by slow cooling from 1200° F. can be avoided by cooling in air from above this temperature if the sections are thin; a water quench is necessary if too thick. Regardless of the fact that annealing may restore such properties as high tensile strength, increased hardness, ductility, etc., weld deposits in these alloys never are as ductile as the original material. The best answer to all this, then, is for the welder to lay small beads and avoid unnecessary heat build-up.

Metallic Arc Welding of Stainless Steels

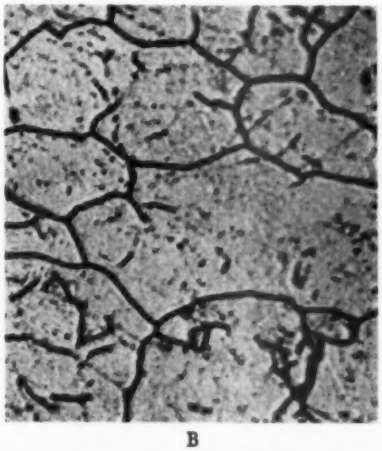
General Notes

Metallic arc welding is very generally employed in fabrication of stainless steels because it is a method by which very satisfactory joints can be installed. A satisfactory joint is one which carries across its zone the characteristics of the materials it joins. Arc welding helps the welder avoid the twin hazards of high heat and holding the metal for a long time at high temperatures, because heat may be applied with accuracy at the point needed, the amount of heat (welding current) can be closely controlled, and heating starts and stops with the arc as does deposition of metal.

Another factor contributing to the satisfactoriness of arc-weld deposits is that its composition is subject to close control becouse it is a fusion of the metal being joined with the metal in the electrode; the compositions of both are accurately known and there is no contamination from the heat source. Still another factor is that the fused metals are protected by the material of the welding flux which coats the rod; it protects the metal as it is transferred from the rod to the deposit, and, being lighter than the metal, rises to the top and protects the hot deposit from air after the arc has passed on.

Intelligent care in selection of the appropriate analysis of rod is as important as selection of rod diameter. This care makes certain that deposited

A



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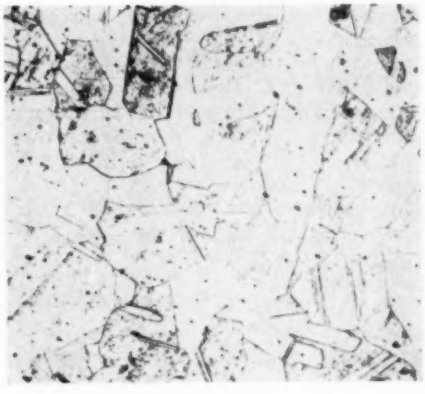

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Fig. 1—(A) austenitic grain structure in base metal, before welding. Outlines of crystal grains as seen under the microscope show no carbide present at the grain boundaries. (B) Carbide precipitation at grain boundaries occurring in base metal adjacent to weld deposit. Dark areas indicate carbides which may be produced in intercrystalline zone by long-time holding in the 800-1500 F. range. (C) Same area after heat treatment to re-dissolve carbides. Metal is restored to original condition as shown in (A). (Made visible under the microscope by etching with suitable solution)

More than 80,000 pounds of 1-in. diameter stainless steel tubing were used in the heat exchangers of the Richfield Oil Corp. refinery at Watson, Calif.

Table I

(Typical Loss of 18-8 Welding Rod Elements)

Element	% in Rod	% in Weld Deposit
Chromium	19.0	18.0
Nickel	9.0	9.0
Columbium	1.25	0.90-0.85
Titanium	Not used	Practically all lost
Molybdenum	3.5	3.5
Phosphorus	0.03	0.03
Carbon	0.08	0.08

metal will closely approximate composition of the metal to be welded. Some of the ingredients of the alloy are partially lost in passing through the arc and must be compensated for in the welding-rod analysis. Typical losses in welding rod elements are shown in Table 1. These figures are only approximations, however, as much depends on the type of flux present on the rod.

The small amount of chromium loss, as noted in Table 1, might be very important in certain chemical installations. About 30% of the columbium content is lost in the arc; it will have a definite effect on carbide precipitation if not present. About 85% of any titanium present would be lost in the arc, so much that it is impractical to include it; columbium-bearing rods must be substituted in welding titanium-bearing stainless steels if service conditions will permit. Nickel, molybdenum, carbon, and phosphorus are not lost in the arc, but carbonaceous material must be avoided in the flux to control carbon in the deposit.

Direct current is by far the most generally employed medium in arc-welding and lends itself to reducing necessary heat input to the base metal being welded. The positive end of the arc is the hottest. If the work is connected negative and the electrode positive, the hot positive end is in the rod, facilitating melting, and the colder negative end is in the base metal where the least necessary heat input is usually desirable. Such a connection is called "reversed polarity". It is not considered satisfactory when welding heavy gauge plate because good penetration into the base metal is difficult at best.

Welding current should be adjusted to provide only sufficient heat for good fusion. Current settings for welding these steels are lower than is necessary for ordinary carbon steels, because melting points are lower and electrical resistance is greater. Currents should be determined by experimentation, but as a general point of guidance a good starting point is about 10% lower than for carbon steel. Adjustments up or down from this value can be made as experience indicates.

A short gap between electrode and work will facilitate uniform work by making it easier to direct the depositing metal where it is wanted. Moreover, the short gap helps maintain continuous flux protection over deposited metal. Weaving, except on wide beads, is to be avoided because it may stir the slag particles from weld coatings into the deposit, resulting in porosity.

Last but not least, the area to be welded, as well as all tools and the welding rods themselves, must be clean and kept that way. Scale, grease, and other foreign materials must be removed from the weld area so that the melt will not become contaminated. For cleaning the weld area, stainless steel wool and a stainless steel wire brush are necessary; if ordinary steel wool or a steel brush is used, particles will be left in the weld which may rust out, or present a good opportunity for corrosive attack. Chill bars made of copper will be found useful because of their high heat conductivity; steel hold-down bars may also be faced with copper.

When a weld bead is laid on one of these steels, for example an 18-8 unstabilized stainless steel, for a certain distance out from the bead, on each side, there will be a graduation of temperatures ranging from that of the molten pool to 800° F. near the outer edge. In this area there will be a band whose side nearest the bead will be at 1500° F. and outside edge at 800° F. It is in this band that carbide precipitation takes place, and because of the low heat conductivity of the steel, this band will remain a relatively long time at this temperature. It is obvious that if chill-bars are laid adjacent to the area to be welded, heat will be more rapidly dissipated and less carbide will form than if the area is allowed to air cool by natural conductivity. Also, if the chill-bars are clamped down tightly, the work is kept in alignment, which helps minimize distortion and warping.

As has been previously explained, carbide precipitation can be reduced, or entirely prevented, by use of columbium — or titanium — bearing alloy ("stabilized" alloys), if service conditions will permit. Heat-treating also will remove carbides. Moreover, if the weld is in a thick section, conceivably parts of the weld bead would be held so long in the carbide precipitation temperature range that relatively large amounts of carbide would be formed. The most logical answer to this, again if service conditions will permit, is to use columbium-bearing welding rods. Tests for carbide precipitation consist of boiling the suspect area in etching solutions, with microscopic examination of the etched surface.

Butt welds are readily made in all thicknesses of stainless down to about #20 gauge with the metallic arc. Below #16 gauge and down through #24 gauge, it is desirable to employ welding machines which are especially constructed for light gauge welding.

On the very light gauges, the welder is faced with the problem of avoiding piercing or holing through. This is a difficulty which takes considerable practice and skill to avoid. Such puncturing occurs due to the intense heat of the arc causing quick melting of thin base metal at the point of contact because there is "not enough body to work with". For this reason, gas welding is quite popular on light gauges; the flame is not as sharp and piercing as the arc.

Butt welding joints may be shear-cut in gauges up to #10 (0.1406 in.). A gap is left between the edges in gauges from #16 to #10 to aid in securing penetration of the filler metal through the entire thickness of the joint; gauges higher than #16 may be set up without a gap.

Butt welds in gauges including #10 down to ½-in. thicknesses are "V"-grooved or beveled on each side, the angle of bevel being generally 30°. Bottom of the "V" is from 1/32 to 1/16 in. above bottom of the joint. Bottom edges may be in close contact or slightly separated, depending on jigging arrangements.

On thicknesses ½ in. and greater, the edges are V'd from both sides or U-

grooved on one side, leaving about 1/16 to 1/32 in. of blunt edge at the center for the former. Gap is 1/16 to 1/32 in. wide. The U-groove is quite commonly used on very heavy thicknesses of stainless.

Welding on double-V's is two-sided; this may also be the case with U-grooves. Two-sided weldings have the disadvantage that the first weld bead or beads is again going to be heated to within the carbide precipitation range, and presumably, the interior will cool more slowly because of the greater bulk of metal involved. This increases chances for carbide precipitation in the first bead, resulting in generally less corrosion-resistance than the metal of the second bead. For this reason, it is desirable to make the first bead of such dimensions that it will, presumably, carry most of the load. The second bead then will be a light one, which can be ground down flush with the surface of the metal and serve as the side in contact with the corrosive material, since it will have the highest corrosion-resistance. Or, the second bead could be laid with a high-chromium rod in the event a rod stabilized with columbium was not permissible under service conditions.

In multiple-bead welding, where two or more beads are laid over each other, or two-sided welding is performed, it is very necessary that flux overlying the first bead be thoroughly removed before the next bead is laid to avoid contamination. Double fillet welding is a good example.

If the bead is so long that one electrode is not sufficient to complete the weld, flux will solidify between the time the arc is broken, the short electrode removed, a new one inserted in the holder, and the arc restruck. This necessitates double heating the *same* spot to high temperatures. This is undesirable because of the enhanced probability of forming carbides both in the weld metal and adjacent walls of base metal. But, if *two* men are doing the welding, one can start the instant the other removes his electrode for renewal. Another way this can be accomplished is by having two electrode-holders, one being used by the welder, and the other kept ready-loaded to be handed him by a helper as soon as his electrode is removed from the work.

A marked advantage in the use of stabilized alloys—containing titanium or columbium—is that the weld may be stress-relieved by heating up to the carbide-precipitating range and then slowly and uniformly cooled down without danger of weakening the corrosion-resistance of the weld or base metal. If unstabilized alloys are used, the temperature must be raised to the much higher values of 1850-1900° F. and then quickly and uniformly cooled. Such an operation, while the heating would restore corrosion-resistance by redissolving the carbides, leaves considerable room for doubt on how much stress-relieving has been accomplished.

Weld spatters adhering to adjoining

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surfaces can be removed with a cold chisel while adherence to base metal may be reduced by applying any of several prepared coatings before welding starts. Spatters always should be removed, as they may be the starting point for corrosive action later. Oxide coatings, recognizable by tinting appearing along weld zones, also may prove points for corrosion attacks; they can be removed by grinding or pickling, since they are confined to the surface.

All that has been said concerning joint preparation, alignment, and grooving for various thicknesses of Ni-Cr stainless steels applies to straight chromium steels. However, the straight chromium steels are not subject to changes in corrosion-resistance through formation of carbides. The one important difference is that high-chromium alloy welds *do* become brittle and lose ductility after welding, whereas Cr-Ni steels do not; heat-treating of the former to improve physical characteristics is necessary, but this must *not* be carried so far as to induce embrittlement through excessive increase of grain size.

Because of the loss of ductility and increased brittleness along the weld, welds in straight chromium steels are prone to show cracking from the high magnitude forces—stresses—induced by expansion and contraction under intense heat. It is thus necessary to preheat the area to be welded to temperatures of 350-400° F. and to postheat to around 1400° F. with an acetylene flame followed by air-cooling. If desired, however, postheating may be handled in a furnace.

Another way to minimize brittleness and loss of ductility in the weld is by use of Cr-Ni rods and, perhaps, use of "modified non-hardening" steels as base metal. Assuming the weld is made with a Cr-Ni rod, stabilized with columbium to prevent formation of harmful carbides, there are two additional factors which must be considered. One is that the Cr-Ni alloy has a greater coefficient of expansion than straight Cr alloy, and if the fabrication is to be exposed to high temperatures, stresses in the weld will develop which may give rise to warping or actual rupture. This is possible because the area adjacent to the weld will have lost some ductility and will have some brittleness because it, too, was heated during welding. The other factor is that, depending on the nature of the materials with which the fabrication may come into contact in service, the presence of two unlike metals in close contact may be definitely undesirable. This, however, might be avoided by finishing-off with a high-chrome alloy rod, provided that trouble from different rates of expansion of Cr-Ni alloy and high Cr alloy is not a factor. The service limit for this combination is an absolute maximum of 1000° F.

Oxy-acetylene welding is suitable for joining stainless steels under certain conditions; when those conditions are satisfied, very good results are obtained. These conditions are: (1) The flame must be neutral, ideally; practically it must be as nearly neutral as possible with any preference shown for adjustment on the oxidizing side. (2) The rod and deposit must be protected from the atmosphere, either by use of flux or by manipulation of the neutral gases of the flame.

For these reasons, it is with light-gauge chromium-nickel steels, stabilized with columbium or titanium, that gas welding finds its widest application in the field of stainless steel fabrication. Where corrosive conditions are very mild, gas welding may be employed on light gauge, unstabilized chromium-nickel steels, provided the work can be adequately protected from excessive heat by cooling bars.

Experience indicates that the employment of tips one or two sizes smaller than those used with similar gauges of plain steel is good practice. By keeping the tip pointed down the joint in the direction the weld is being made, a certain amount of preheat is obtained ahead of the puddle. This practice also keeps the heat off the deposited bead and permits more rapid cooling. As in the case of arc welding, the more quietly the puddle can cool, the better. Excessive agitation of the puddle may result in unsound metal.

Joint design and jigging arrangements are basically similar to those employed with the metallic arc. It will be evident, however, that the greater amount of heat from the torch will make it desirable to use cooling bars or chill plates of larger size for increased heat absorbing capacity. Extra precautions may also be necessary to control warpage. Where jigs are not available, the edges are set up and held by tacks spaced at intervals determined by experience.

As mentioned, the gaseous products of a neutral flame afford protection to the puddle, the surrounding metal, and the melting end of the filler rod. They cannot, however, be depended upon to protect the under side of a joint. For this purpose, and also at times to increase the protection on top, fluxes should be employed. There are a number of preparations on the market which are usually applied in the form of a paste. These may be brushed over the surfaces to be protected and allowed to dry. Rod ends may be dipped into them. The surface of the deposit is benefited, as the flux tends to collect over the bead and protect it, keeping it smooth.

As a general rule, the use of oxy-acetylene welding is not recommended for the straight chromium alloys. Holding them for extended periods at high temperatures leads to grain growth and results in brittleness.

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Principles Governing Catalyst Reactions Studied in Extensive Research Program

234.4
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A VARIED program of fundamental research into the mechanics of catalysis and chemical engineering problems is being carried on by the chemical engineering department of the University of Wisconsin under the direction of Drs. O. A. Hougen and K. M. Watson, both research professors in chemical engineering. While the studies pertain generally to all problems encountered with solid catalysts, the work is of particular interest to petroleum refiners because the findings will apply to the solid catalysts now being used in the manufacture of chemical products from petroleum, such as butadiene, aromatics, 100-octane gasoline components, etc. Indeed, at least two of the reactions now being studied are in use by the petroleum industry today; catalytic dehydrogenation of butylenes to butadiene and catalytic dealkylation of aromatics.

The ultimate aim of the work is not to develop new catalysts or new processes, but so to determine the basic fundamentals of catalysis that pilot plant work can largely be eliminated and the first commercial plants utilizing a catalytic process can be designed to attain maximum efficiency. Thus, much of the later change in plant design now necessary to secure improvement in the catalytic reaction could be avoided.

At present, the following research programs are in progress, sponsored by the department with funds granted by the Wisconsin Alumni Research Foundation: "Effect of Catalyst Size and Shape," "Through-Circulation Drying," "Solid Catalysts and Reaction Rates," "Activated Adsorption on Catalysts", and "Diesel Engine Combustion Studies." A project, "Hydrogenation of Iso-octene," initiated and sponsored by Universal Oil Products Co., has the experimental work completed, with correlation of data now in progress. The Gulf Oil Corp. is sponsoring a research program to investigate catalytic reaction rates, which is catalogued as "Dehydrogenation of Butane to Butene." The War Production Board is sponsoring "Catalytic Dealkylation of Aromatics," "Separation of Chlorine from Sulfur Dioxide by Chemical Means" and "Dehydrogenation of Butene to Butadiene."

Reports Published

A number of research programs at this institution have been completed within the past year and preliminary reports have been published on several of the investigations still in progress. Among the former, of particular interest to refinery technologists are: "Mass Transfer in Heterogeneous Reactions" (Trans. Am. Inst. Chem. Eng., 39, 1-35, 1943), "Flooding Velocities in Packed Columns[1]," "Thermodynamics of the Liquid State" (Ind. Eng. Chem., 35, 398, 1943), "Oxidation of Sulfur Dioxide" (Ind. Eng. Chem., 34, 544, 1943), "Thermal Properties of Hydrocarbons"[2] and "Vapor Pressures of Organic Compounds"[2]. Preliminary reports have been published on "Hydrogenation of Iso-octene" (Ind. Eng. Chem., 35, 554-563, 1943) and "Solid Catalysts and Reaction Rates" (Ind. Eng. Chem., 35, 529-541, 1943).

Perhaps of greatest interest and future value to refiners and refinery technologists is the fundamental research on catalytic reaction rates. It is only within the last few years that any great amount of catalytic cracking has been done commercially. Today, not only catalytic cracking but catalytic polymerization, hydrogenation, dehydrogenation, oxidation and isomerization have assumed great importance. Some who have gazed into the crystal ball predict that entrance of oil companies into the chemicals-from-petroleum field will require greater amounts of catalytic equipment than refiners have yet dreamed of.

Process Design Involved

The development and construction of a modern refinery involves two types of design; mechanical design and process design. The former is old, with basic principles well-established, but the latter is new and still in the stages of formulation. Study in this field in the University of Wisconsin program is centered chiefly around the determination of production rates—how fast each step in the process shall proceed. Problems in production rates may be broken down into unit operations, such as flow of fluids and transfer of heat, and applied chemical kinetics, which involves the problems of unit operations combined with problems of activated adsorption, the behavior of catalysts, and surface and volume reactions.

The objective of all this work is to supply data by means of which industrial equipment may be designed which will carry on reactions with the greatest economy of space, materials, heat and power, under conditions of optimum temperatures, pressures, and concentrations. Thus, once the fundamental equations for a given reaction are known, it will be possible to step immediately from the laboratory pilot plant to the final design of a full-blown commercial plant, without the necessity for trial-and-error revampings over a period of years to attain the same degree of operating efficiency.

Catalytic reaction rate research has been based on findings in the periodical literature that a liquid- or gas-phase reaction, when catalyzed by a solid, occurs on the surface of the catalyst, being effected by the catalyst's ability to adsorb the reactants in such a form that the activation energy necessary for reaction is reduced far below its value in the uncatalyzed reaction. From these principles equations are being developed to extend and interpret production rate data and to point out experimental procedures to evaluate completely these equations from a minimum of data, and also to develop methods for using such equations in the design of industrial equipment.

Some of this recent work on solid catalysts and reaction rates at the University of Wisconsin has been derived, oddly enough, from experiments with a through-circulation dryer. By careful study of the rates of evaporation of water (mass transfer) from various sized and shaped particles, it has been found that the same basic equations apply in the combustion of coal, hydrogenation of iso-octene and catalytic polymerization of hydrocarbons, for example. Because of the differences in the mechanisms involved it has been necessary to break down the steps as follows:[3]

Steps in Reaction Rates

"1. The mass transfer of reactants and products to and from the gross exterior surface of the catalyst particle and the main body of the fluid.

"2. The diffusional and flow transfer of reactants and products in and out of the catalyst particle when the reaction takes place at interior interfaces.

"3. The activated adsorption of reactants and activated desorption of products at the catalytic interface.

"4. The surface reaction of adsorbed reactants to form chemi-sorbed products".

Research equipment at the university is set up to permit evaluation of these separate factors. Then that particular factor which is the slowest may be considered as the "rate-controlling factor".

Investigations into specific catalytic reactions, such as hydrogenation or dehydrogenation, and other projects previously mentioned, are being set up to determine the basic factors involved in the reaction in question. Also involved in the problem is the size and shape of the catalyst particles themselves, as well as the way in which they are placed in the

[1] Delivered before American Institute of Chemical Engineers, Pittsburgh, Nov., 1943; to be published in the Institute's "Transactions," 1944.

[2] Presented before Petroleum Division, American Chemical Society, Pittsburgh, Sept., 1943.

[3] Hougen, O. A., and Watson, K. M., "Solid Catalysts and Reaction Rates", Ind. Eng. Chem., 35, p. 529, May, 1943.

reaction chamber. It has been learned that it makes a great deal of difference in rate of flow of fluids through the chamber whether the particles are individually laid in place, dropped in by the handful, or dumped in by bucket. Rate of flow with its accompanying variations in turbulence, among other factors, may have a marked effect on the final reaction rate or degree of conversion, ignoring entirely rates of heat transfer and other variables which also complicate the picture.

Special Apparatus Designed

In designing apparatus to study the development of rate equations for hydrogenation of iso-octene, the catalytic chamber was constructed to permit detailed examination of what was going on. The catalyst bed could be so varied as to simulate an entire commercial bed, or it could be varied so as to simulate any portion of such a bed. In the experimental equipment for this reaction thus far reported[1], the reactor was combined with the charge preheater. This report states:

"The preheater and reactor consist of a single aluminum bronze block, machined in the form of a cylinder, 4.75 in O.D., 1.25 in I.D., and 39 in. long. The upper third of this cylinder is the preheater section, and the lower two-thirds the reaction chamber. The preheater section is enclosed by a 2000-watt radiant electrical heater; a small-link brass chain is used as packing material to afford good thermal contact and a high degree of turbulence. The reaction chamber is enclosed by a 20-gauge welded stainless steel sleeve having an inside diameter ⅛ in. greater than the outside diameter of the aluminum bronze cylinder. Air is blown through the annular space between the cylinder and sleeve to remove the heat of reaction and to minimize the temperature gradient in the reaction zone. A 4000-watt, 220-volt radiant electrical heater encloses the stainless steel sleeve. The entire block and heaters are mounted in a 10-in. transite pipe; the annular space is packed with rock wool insulation.

Temperature Controller

"The temperature of the preheater section is maintained constant by a controller which utilizes the difference in the coefficients of expansion of porcelain and aluminum bronze to operate a micro-switch through a lever system. The micro-switch actuates a magnetically controlled mercury switch which opens and closes the heater circuit. The reactor section is maintained at a constant temperature by a controller similar to the one on the preheater section and by regulating the flow of cooling air through the stainless steel sleeve. The temperatures of the preheater and reactor are measured by iron-constantan thermocouples placed in wells in the aluminum bronze cylinder. In addition, there is one thermocouple in the gas stream immediately below the catalyst bed and another in the gas stream slightly below the top surface of the catalyst bed."

Experimental data from this investigation seem to indicate that the controlling step in this reaction is the rate of surface reaction, the mass transfer step being negligible, and adsorption equilibrium being maintained between gas phase and adsorbed components.

In another investigation series, that of catalytic dehydrogenation of butane to butene and butene to butadiene, sponsored respectively by Gulf Oil Corp. and the Office of Rubber Director, it is intended to have the investigations parallel the operation of at least one synthetic rubber plant which now is nearing completion. Results of the latter investigation especially will be transmitted to the plant operators, so that commercial operations may keep pace with research findings.

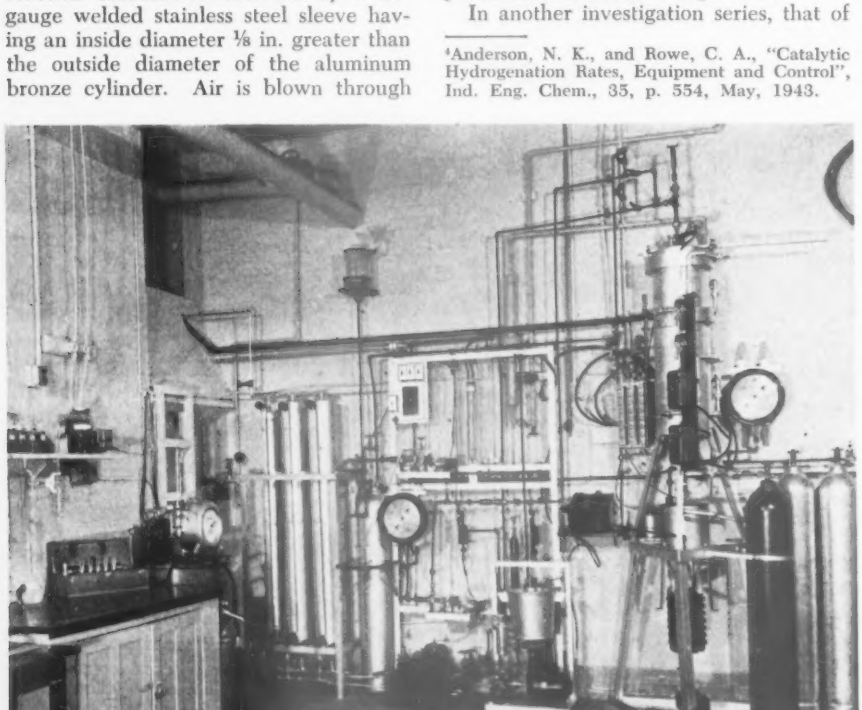
In this connection, a new spectrophotometer has just been acquired by the University of Wisconsin laboratory. This instrument is widely used in synthetic rubber plants and butadiene plants to detect and determine concentration of butadiene in cracked gases and reactor effluents. Where concentrations are high, however, the general practice is to determine the impurities, computing the concentration of butadiene by the difference.

Diesel Engine Research

A research program which is expected to be of great interest to Diesel engine designers and oil companies alike is that of "Diesel Engine Combustion Studies", sponsored jointly by the chemical and mechanical engineering departments. This research is to develop technique for a simultaneous measurement of temperature, pressure, and radiation intensity during the combustion stroke of the engine. Temperature, pressure, and radiation intensity will be correlated with the crank angle of the engine, and the whole will be registered on oscilloscopes. With the engine conditions in equilibrium, the cathode-ray traces on the various oscilloscopes will be practically stationary, permitting recording by a camera. Instantaneous temperature measurements will be possible by means of a photoelectric pyrometer, which, working on two wave lengths of light simultaneously, will eliminate the usual errors with such instruments.

From the data secured on this engine, it is hoped that sufficient new light can be thrown on combustion phenomena to lead to improvements in engine design and operation, and perhaps on fuel compositions as well. Construction of the special instruments is about completed and investigations are expected to begin shortly.

[1]Anderson, N. K., and Rowe, C. A., "Catalytic Hydrogenation Rates, Equipment and Control", Ind. Eng. Chem., 35, p. 554, May, 1943.



Research equipment used at the University of Wisconsin to study rate factors in the hydrogenation of iso-octene. At right is shown the reactor-preheater sections

BOOK REVIEWS

Book on Plastics Revised To Cover New Uses

"Industrial Plastics", second edition, revised, by Herbert R. Simonds, contains an up-to-date discussion of the many new types of plastics and their applications in industry. The author states the book is written purposely in a non-technical (or semipopular) style but that technical men and research workers in many fields may find it valuable because of its industrial emphasis, a phase too often divorced from the laboratory. The book, however, covers the whole plastics industry—composition, physical properties, fabrication, design, industrial application, and foreign practice.

Progress in plastics has been so rapid since the appearance of the first edition in 1939 that it was necessary to rewrite a considerable portion of the text for this second edition. The chapter on "Future of Plastics" includes a section on plastics in wartime, and other data and statistics have been brought up-to-date. Material on the chemistry of plastics has been revised in the light of late research.

"Industrial Plastics" contains 385 pages of text and illustrations and may be purchased through the Book Department of NATIONAL PETROLEUM NEWS, 1213 W. Third St., Cleveland, for $4.50.

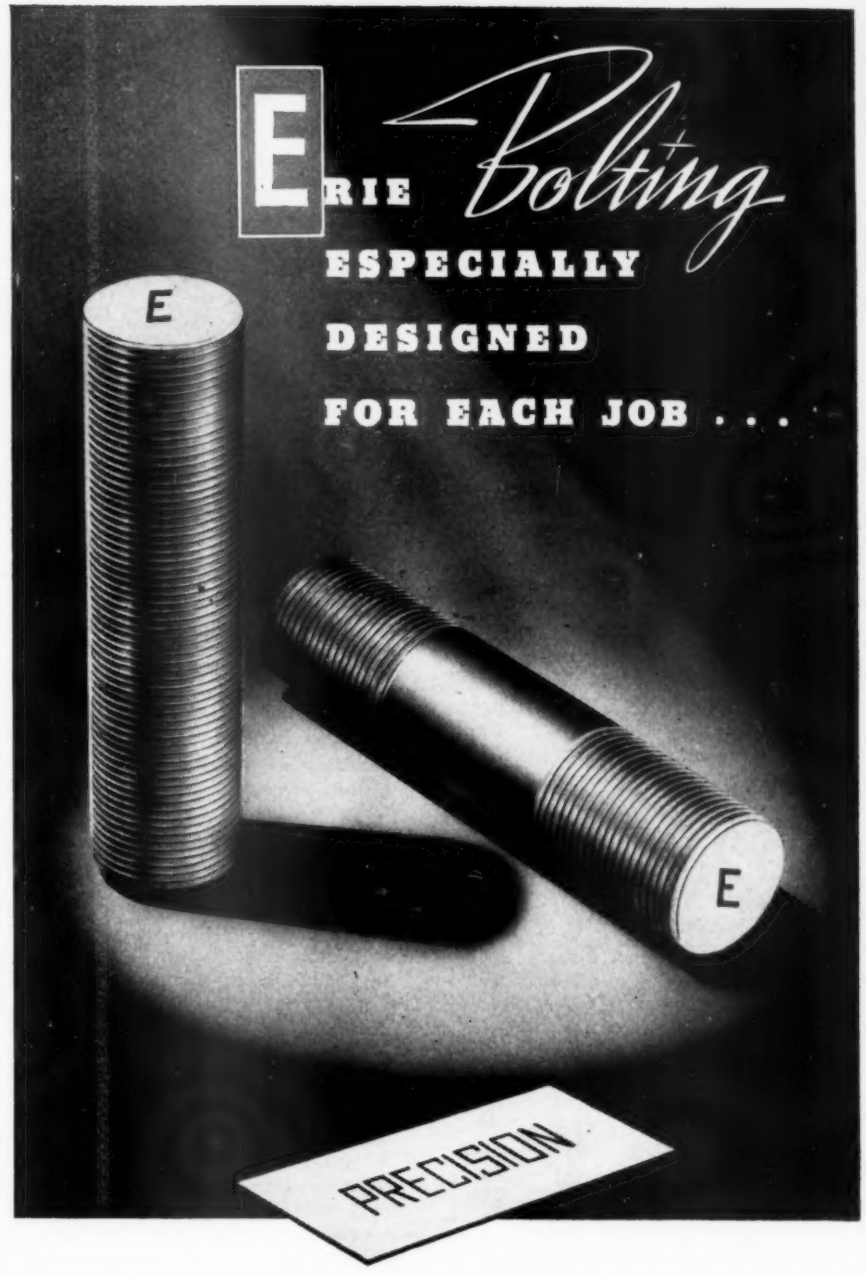
Examples of Arc Welding In Plant Maintenance

"Maintenance Arc Welding", published by the James F. Lincoln Arc Welding Foundation and containing several chapters of interest to refinery maintenance men, deals with the use of arc welding in reclaiming broken and worn parts and in the fabrication of replacements.

The book comprises 25 papers selected as outstanding in the maintenance classification of the Foundation's latest award program. Many different industries and applications are represented in the papers selected.

Chapters of interest to refiners are "Cracking Still Charging Pump," by George M. Heath of Pure Oil Co., "Corrosion Control in Refinery Pressure Vessels," by W. W. McClow, formerly of Pure Oil Co., and "Oil Still Tubes" by L. V. Hile of Phillips Petroleum Co. (The first and second of these papers appeared in the Technical Section of NATIONAL PETROLEUM NEWS in the Aug. 4, 1943, and Jan. 6, 1943, issues, respectively).

"Maintenance Arc Welding," may be purchased through the Foundation, P. O. Box 5728, Cleveland, Ohio, for 50c within the U. S.



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"Contactor" Is New Equipment For Alkylation Plants*

THE alkylation contactor, whether the catalyst is hydrofluoric or sulfuric acid, is essentially a hydraulic mixer. In either case it is required that the reacting hydrocarbons be rapidly and intimately mixed with each other and with catalyst. Accordingly, the mixer must assure sufficient turbulence to attain instantaneous intimate contact between reagents, while permitting sufficient throughput to give desired contact time.

A second requirement of the alkylation process is that the proper reaction temperature be constantly maintained during a reaction that is inherently exothermic. The contactor contains the appropriate heat-exchange elements to assure this control. Depending upon the reaction temperature desired the cooling is accomplished either by circulating water through the tubes or by flooding the tubes with a mechanical refrigerant such as ammonia or propane. In either case the cooling medium enters at the top of the contactor, flows downward through the small center tubes and then upward between the center tubes and the large outside finned tubes.

A third requirement of the process is the establishing of a high ratio of isobutane to olefin in the reaction zone. The impellers in the contactors are capable of maximum circulating rates ranging from 30,000 gal. per minute for the size 30 machine with 24-in. impeller to 50,000 gpm for the size 50 machine with 35-inch impeller. This circulating stream is a mixture of acid and hydrocarbon, the latter predominating in isobutane and alkylate since the olefin has all been converted in the reaction.

As shown in Fig. 1, the composite feed containing isobutane and olefin enters at the bottom of the contactor, just above the impeller, where it meets the large circulating stream. Here the olefin containing feed is immediately dispersed in the large stream of acid, isobutane and other hydrocarbons and the mixture is thrown around the bottom head and upward around the outside of the contactor which is circular in horizontal cross section. At the top of the contacting section it enters the heat-exchanger section where it is distributed by vanes and baffles, passing downward through the exchanger, where it is again picked up by the impeller for the upward trip. Acid enters at the top of the exchanger head, is caught by the stream from the impeller and passes downward.

Effluent from the contactor, a mixture of excess isobutane, unavoidable inert components of the feed, catalyst acid, and alkylated product, leaves at a point diametrically opposite to catalyst-acid entry and at the same level. The equipment is operated liquid-full at pressure sufficient to maintain feed and products in liquid-phase at reaction temperature. The impeller is driven through a right angle gear and a parallel shaft reducing gear direct connected to a steam turbine.

The contactor is constructed of low-carbon steel, considered to be an excellent resistor of corrosion from the catalyst acid. All parts which come in contact with hydrofluoric acid, especially, either concentrated or in the feed and alkylate, must be leak proof. They may be cast or forged. For hydrogen fluoride specifically, castings must not contain sand inclusions, for the acid reacts vigorously with silica.

In order to keep the corrosive contents of contactors from the impeller bearings or from leaking out of contactor or pumps, special double mechanical seals capable of resisting corrosion are required. The rotating rings are made of low carbon steel hard surfaced with Stellite. The stationary rings are made of metal impregnated hard burned carbon or acid resisting bronze. The contact surfaces of both are "superfinished" to near optical flatness. The seals are held in close contact by springs, evenly spaced around the circumference of the rings. Backing up this is the lubricating oil circulating through the bearings, automatically maintained at a 35-50 lb. differential pressure over system pressure. Thus, if the seals should leak, circulating oil will flow into the contactor rather than the reverse, and loss of lubricating oil in oil sets will indicate any seal failure.

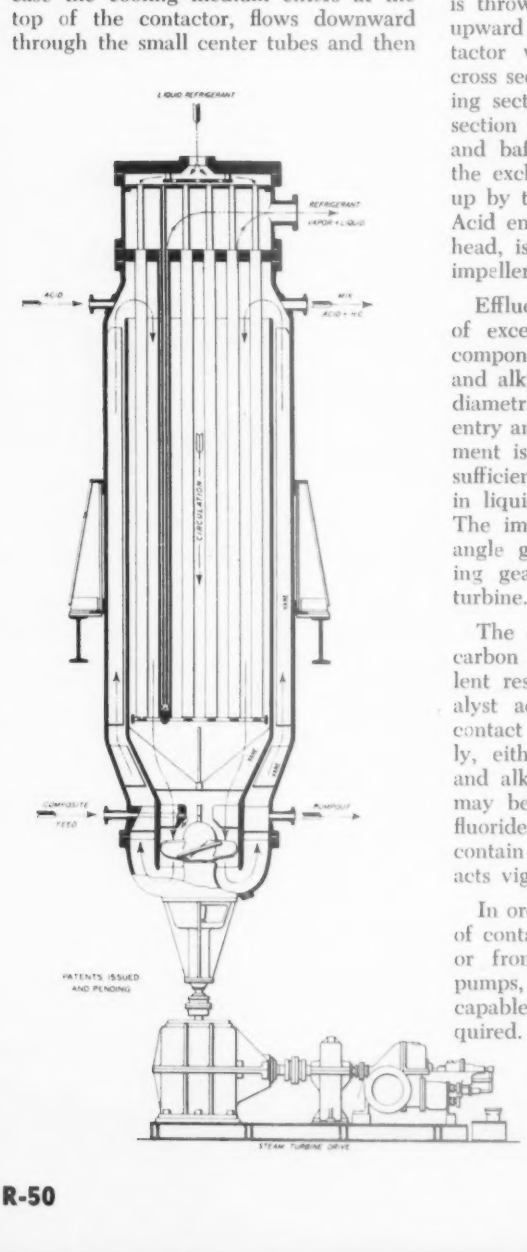

Fig. 1—Alkylation contactor for hydrofluoric acid or sulfuric acid alkylation plants

Settlers And Pumps

The acid is separated from the mixture of unreacted hydrocarbon feed and alkylated products in decelerating settlers. Effluent from the contactor is charged under the hood in the settler, substantially oil-free acid is continuously withdrawn from the bottom, and substantially acid-free oil from the extreme top of the settler. The mixture to be settled enters through a slotted-pipe inlet manifold arranged under a hood for the purpose of preventing turbulent flow in the body of liquid in the settler. This reduces flow rate of the entering liquid from several feet per second to a small fraction of an inch per second before it enters the settling zone. The mixture then quickly separates by gravity into three phases: oil, oil-acid emulsion, and acid. Sufficient residence time is provided in the settler to cause the emulsion also to break down into acid-free oil and substantially oil-free acid thus producing only two final phases.

A slotted-pipe outlet header, suitably manifolded, removes substantially acid-free oil from the top of the settler, and a shielded outlet pipe removes oil-free acid from the bottom.

Pumps for handling the acid are of the centrifugal type, so constructed that the mechanism may be removed for inspection and maintenance without disturbing inlet or discharge lines. Pumps are equipped with the same type of hydraulically-operated mechanical seals as in the contactor itself. The metal comprising the parts in contact with acid is appropriate for the particular catalyst acid to be used.

The arrangement of the contactor section using either hydrofluoric or sulfuric acid, is almost identical. The main difference is an additional settler and heat exchanger where sulfuric acid is the catalyst. The second settler, a soda settler, permits removal of soda added to neutralize any remaining sulfuric acid carried over from the first settler and any acidic compounds which may have been formed. The heat exchanger is used to bring the feed temperature close to desired reaction temperature. Also, acid regeneration may be practiced with either catalyst.

* From "Alkylation Equipment," Service Bulletin 270 of Stratford Engineering Corp., Kansas City.

Control Equipment Designed To Withstand HF Corrosion

Inquiries among the various manufacturers of refinery control equipment as to changes in design made necessary in installations where anhydrous hydrofluoric acid is used as an alkylation catalyst, as in the manufacture of 100-octane aviation gasoline, have developed the following data:

(From Engineering Dept., Fisher Governor Co.)

NEW features in the design and construction of refinery control equipment have been made necessary by the use of hydrofluoric acid as a catalyst. Certain metals and materials, normally used in the construction of control valves and liquid level controllers are subject to the action of this acid and must be replaced by other materials which are resistant to the acid. Furthermore, hydrofluoric acid is highly toxic and requires extreme care in safeguarding against leakage such as might occur through a stuffing box.

Fisher Governor Co. engineers have developed a diaphragm motor valve especially designed for this service. (See Fig. 1) The body, inner valve, seat rings, and all other parts exposed to the fluid under control, are of silicon free iron, steel or other metal resistant to hydrofluoric acid. This controller also incorporates an extension member on the bonnet or head that is specially designed to prevent the fluid from coming in contact with the stuffing box packing which is readily attacked by the acid.

Sealing gland member "A" is made up of close fitting steel packing rings through which the valve stem passes. A fluid, the same as that passing through the main valve but which does not contain hydrofluoric acid, (or a fluid which will not contaminate or adversely affect the material in the main line due to slippage leakage past the gland), is introduced at inlet "B" at a pressure slightly in excess of the main line downstream pressure. The pressure above Gland "A" prevents any leakage of the acid containing fluid around the valve stem and eliminates the danger of leakage through the stuffing box to the atmosphere.

Required pressure at "B" is maintained by a specially designed regulator acting as a differential valve. (Fig. 2) Downstream main line pressure is applied on the top of the regulator diaphragm to act as the loading pressure. As this pressure varies, a corresponding pressure variation is effected at "B", thus maintaining a constant differential between the gland seal pressure and the pressure in the outlet side of the valve body.

Experimental work and pilot plants have proved that the best trim material for valves and seats is a low silicon carbon steel in preference to stainless steels. Low silicon cast carbon steel materials for valve bodies must also be used, since iron with its high silicon content is very readily attacked by hydrofluoric acid. Gaskets should be soft iron on all gasketed surfaces, though all joints should be preferably avoided by use of welded fittings. In small valves no screwed fittings should be used, socket welding being desirable for valve ½ in. and under.

* * *

By George F. Scherer,
Director of Research, Merco Nordstrom Valve Co.

VALVES INTENDED for handling anhydrous hydrofluoric acid, either alone or in conjunction with hydrocarbon material, are made of ordinary low carbon steel with the exception of several features which modify the otherwise standard design. The several changes which have been incorporated are described as follows:

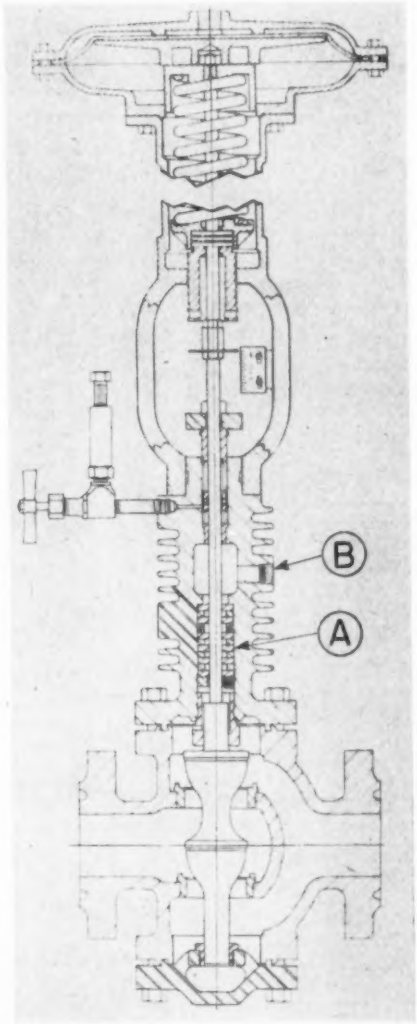

Fig. 1—Diaphragm control valve with the special sealing gland member

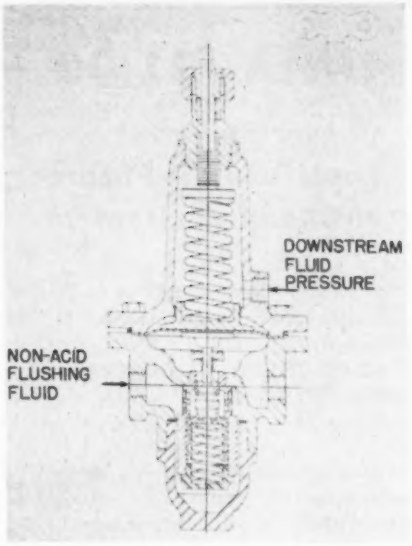

Fig. 2—Special differential type pressure reducing valve used to maintain the differential between the flushing fluid pressure and the downstream reduced pressure

The standard plastic packing which contains asbestos fibre has been replaced by a new packing. The exact composition of this packing cannot be made public but we may say that it contains no asbestos and is composed essentially of a special lubricant, graphite, and pulverized cork. Numerous tests have demonstrated that this packing is highly resistant to the attack of hydrofluoric acid either dilute or anhydrous. The valves are packed by inserting sticks of this plastic packing in the chamber provided for them and turning in a screw compressor. This permits the valves to be packed under pressure at any time without endangering the operator. The ball thrust bearing in these valves is either a silverplated carbon steel thrust ball or of a corrosion resisting alloy suitable for this purpose. The standard flexible diaphragm which is ordinarily made of a 12% chromium stainless steel has been replaced by a low carbon mild steel diaphragm.

The valves provided for handling the dilute hydrofluoric acid commonly referred to as the "constant boiling mixture" are made of an acid resisting bronze containing 88% copper, 10% tin, and 2% lead. These valves incorporate a standard stuffing box. The packing used is composed of pre-formed rings of shredded copper lubricated with graphite and a plastic ring of special packing inserted in the stuffing box below the rings to provide elasticity and additional precaution against leakage. This property of elasticity

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is a necessary characteristic required in the packing of these valves to permit the proper functioning of the valve when the valve is lubricated and the plug jacked from its seat by hydraulic pressure exerted by the lubricant. The flexible diaphragm used in these valves and the cover gasket are made of soft sheet copper.

Both the above types of valves have been subjected to comprehensive tests under service conditions.

Where corrosion conditions are particularly severe where anhydrous fluoric acid is handled, a type of valve is used the construction of which is essentially identical with the first type described above, except that the sealing surfaces of the plug and body are coated with a hard corrosion resisting alloy welded to the base metal, which provides a maximum of corrosion resistance to these critical parts of the valve.

° ° °

From "Petroleum Notes" of the International Nickel Co., Inc., describing the resistance to hydrofluoric acid corrosion of its Monel metal (a non-ferrous alloy containing 60 to 70% nickel, 25 to 35% copper, 1 to 3% iron, 0.25 to 2% manganese, 0.02 to 1.50% silicon and 0.3 to 0.5% carbon).

Hydrofluoric acid (HF) is rapidly becoming one of the important catalysts used in petroleum refining. Because this acid under certain conditions of elevated temperature is quite corrosive, especially towards steel, extensive investigations have been made to find suitably resistant materials. In these tests Monel has been exposed to HF under a variety of temperature and concentration conditions. See Table 1.

In general Monel has been found to have satisfactory resistance to HF at temperatures up to 250° F. in all concentrations provided that oxygen (air) is excluded and that sludges are not permitted to accumulate on the metal. Tests on Monel in air-saturated solutions show considerably higher corrosion rates than in air-free solutions. However, the limited information from HF process operations indicates that aerated conditions are not common in equipment for which Monel should be considered.

Monel containing approximately 69% nickel, 29% copper appears to be satisfactory in its resistance to both the aqueous and anhydrous forms of the acid. In testing of metals, it has been indicated that copper rich alloys are resistant to the aqueous acid while high-nickel bearing alloys are more satisfactory for the anhydrous acid. Monel bridges both these requirements. Further, its mechanical strength of 75,000-85,000 psi. ultimate, as well as the ease with which it is fabricated and welded, dictates its use in a large number of applications.

Table 1—Monel Corrosion Tests in Hydrofluoric Acid

Material	Acid Conc. %	Temp. °F.	Agitator Gas	Time Days	Area* dm²	CORROSION RATES Mdd†	Ipy‡
AIR-FREE TESTS—Nitrogen agitation rate = 100 cc/min.							
Monel (wrought)	25	86	Nitrogen	6	0.50	1.0	0.0002
(approx. 69% Ni,	25	176	Nitrogen	6	0.50	14.5	0.0024
29% Cu)	50	86	Nitrogen	6	0.50	0.4	0.0001
	50	176	Nitrogen	6	0.50	3.6	0.0006
	25	86	Nitrogen	6	0.13	3.5	0.0006
Monel (cast)	25	176	Nitrogen	6	0.13	8.3	0.0014
	50	86	Nitrogen	6	0.13	2.8	0.0005
	50	176	Nitrogen	6	0.13	13.5	0.0022
	25	86	Nitrogen	6	0.30	1.5	0.0002
"S"-Monel (cast)	25	176	Nitrogen	6	0.30	1.1	0.0002
(approx. 4% silicon)	50	86	Nitrogen	6	0.30	2.3	0.0004
	50	176	Nitrogen	6	0.30	12.1	0.0020
AIR-SATURATED VS. AIR-FREE TESTS							
Air agitation rate = 300 cc/min. . . Nitrogen agitation rate = 100 cc/min.							
	25	86	Air	1	0.50	230.0	0.0380
	25	86	Nitrogen	6	0.50	1.0	0.0002
	25	176	Air	1	0.50	67.0	0.0110
	25	176	Nitrogen	6	0.50	14.5	0.0024
Monel (wrought)							
	50	86	Air	1	0.50	48.7	0.0079
	50	86	Nitrogen	6	0.50	0.4	0.0006
	50	176	Air	1	0.50	241.0	0.0400
	50	176	Nitrogen	6	0.50	3.6	0.0006

* dm^2 = Square decimeter. † Mdd. = Milligrams per sq. decimeter per day. ‡ Ipy. = Inches penetration per year.

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